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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
AND
COOPERATING AGENCIES *

No. 62　　May, 1932　　Missoula, Montana.

DROUGHT NOT YET BROKEN

By George M. Jemison, Junior Forester
Northern Rocky Mountain Forest and Range Experiment Station

Available records do not indicate that the notorious drought of the last several years is as yet definitely broken. On the contrary, indications are that the dangers of exceptional dryness and high inflammability of the forests may be with us in 1932, just as in the four preceding seasons, unless more than normal precipitation occurs within the next few months.

This note of warning is therefore issued to prevent over-optimism based on inaccurate facts or on inferences which might be drawn from publicity of the last few months about the depth of snow in the mountains.

It is true that above-normal depths of snow have been reported from many mountain localities. Witness Priest River, Idaho, for example, where a depth greater than has previously been measured in 20 years occurred at the official snow stake. But an examination of precipitation records for several stations in this region indicates that caution should be used before coming to the conclusion that this plentiful snowfall of the past winter necessarily forecasts improved water supply and ground moisture for the summer of 1932, as compared with the summers of 1928, 1929, 1930, and 1931.

As shown by the attached chart, the records of five stations, representing eastern Washington, northern Idaho, and western Montana, indicate that the region as a whole has not yet received marked relief from the prolonged drought that began in 1928. The records of five other stations, at higher elevations or more representative of forest conditions, also fail to show general relief. As the normals for these forest stations are largely based on only a few years, those data have not been reproduced.

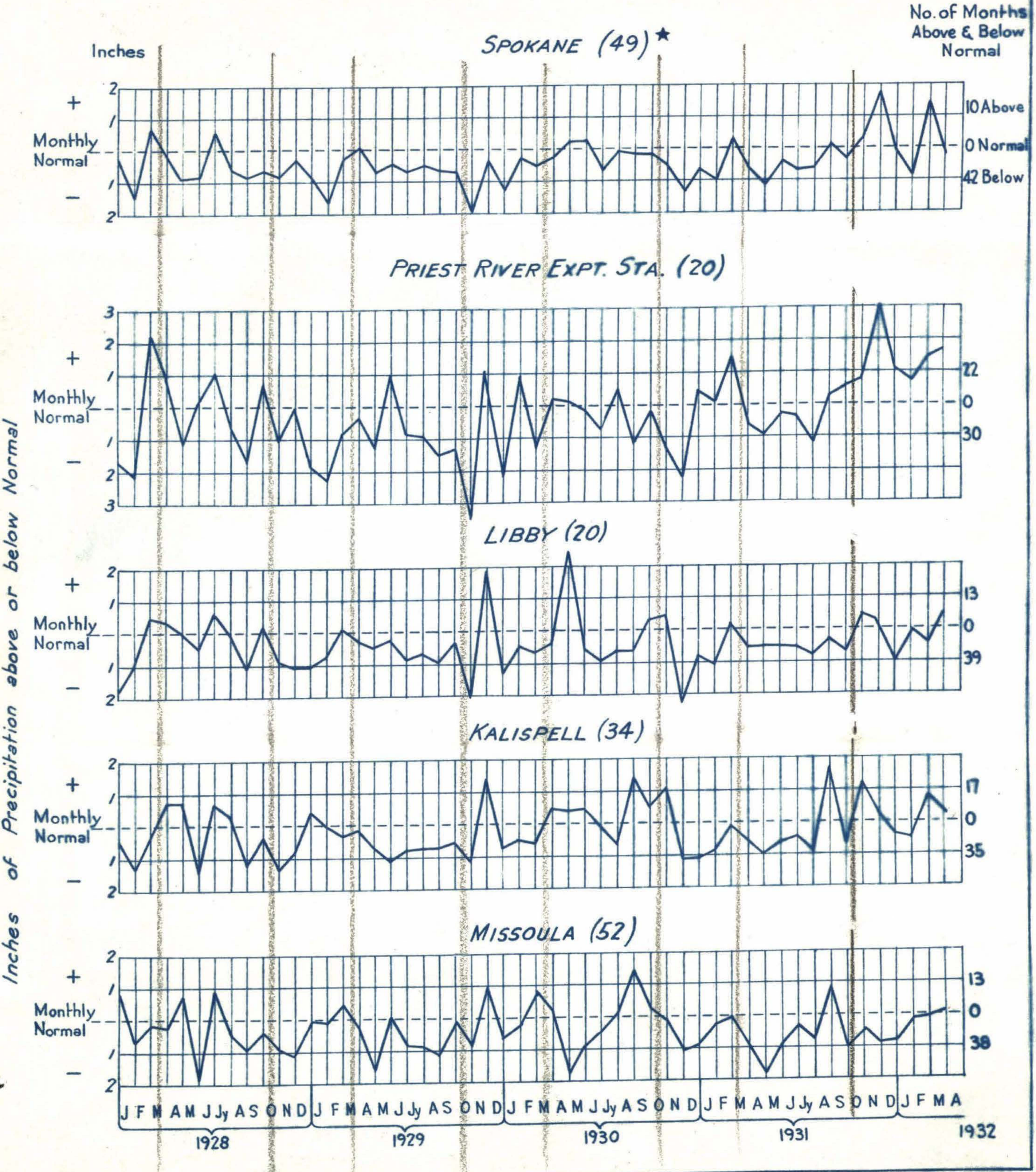
The cumulative deficiency of precipitation in inches from January, 1928, to May 1, 1932, at Spokane was 22.61; at Priest River, 16.31; at Libby °, 21.69; at Kalispell, 11.38; and at Missoula, 18.80. In other words, during the last four years most of the stations have received only three years of normal precipitation. Priest River is the only station that received more than normal rainfall each month during the past winter. Western Montana, however, apparently has received very little more moisture than during any of the three preceding winters.

It would appear from this summary that while there may have been more snow on the ground in February or March, 1932, this probably was due to a lack of current melting rather than to more precipitation.

° Weather bureau normals for Libby include 16 years of records at Troy. In this article these figures have been corrected to show the normals for 20 years' records at Libby, only.

[*] Forest Service, Region One; University of Montana; Montana State College of Agriculture; University of Idaho; Office of Blister Rust Control; Weather Bureau; Bureau of Entomology, and private agencies.

DEPARTURE OF PRECIPITATION FROM NORMAL BY MONTHS
at
SPOKANE, PRIEST RIVER, LIBBY, KALISPELL AND MISSOULA
Jan. 1928 to Apr. 1932 inclusive



★ No. of years record as basis for Normal

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16.111

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16.112 Ponderosa Pine

APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
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No. 63 April, 1934 Missoula, Montana

BREAKAGE LOSSES AND CULL PER CENT OF TIMBER IN THE INLAND EMPIRE

By I. V. Anderson, Associate Forester

The Northern Rocky Mountain Forest and Range Experiment Station recently completed an investigation of breakage losses in felling the most important timber species of this Region. Information on cull per cent was also obtained incidental to the breakage data. The results of this study are presented as briefly as possible without comment on the reasons for the various conclusions.

In computing the breakage and cull percentages for western white and ponderosa pine, the gross volume of trees from the stump to the small end of the top log removed from the woods was used as 100%. In the case of western larch and Rocky Mountain Douglas fir, the gross volume from the stump to a top diameter of eight inches was used as 100%.

BREAKAGE LOSSES

WESTERN (IDAHO) WHITE & PONDEROSA PINE

Per Cent Deduction for Breakage in Felling

Character of Ground (1)		Western (Idaho) White Pine		Ponderosa Pine	
Topography	Surface of Ground	A	B	A	B
Even	Normal	.8	.4	.8	.1
"	Windfall	1.1	.4		
Moderately Broken	Normal	2.4	1.0	1.7	.6
" "	Rocky			1.6	1.0
" "	Windfall	3.6	1.4		
Badly Broken	Normal	7.5	5.5	4.4	1.4
" "	Rocky			4.0	1.2
" "	Windfall	6.3	3.0		
Average of All Classes of Ground and Size of Timber		3.0	1.3	2.0	.6

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(1) Each class of ground under this heading contains variations in slope from level to slopes in excess of 50%.

A = per cent loss from breakage if volume table being used is based on volume of trees from stump cut to an arbitrary top diameter inside bark of 6 inches, whenever practicable to take measurements to this top diameter.

B = per cent loss from breakage if volume table being used is based on actual volume of tree from stump cut to the small end of the top log removed from the woods.

LARCH & DOUGLAS FIR

Logging operations in the larch-Douglas fir type were not very extensive at the time of the study. Timber being logged at that time suffered a loss of 4% for frozen larch and 3% for unfrozen larch. The loss in felling Douglas fir in the larch-Douglas fir type is negligible.

DEDUCTION FOR CULL

WESTERN (IDAHO) WHITE PINE

Cull per cent for this species exclusive of breakage averaged 15%. This figure should be used only as a guide in deducting for cull, or for calculations involving large localities within the western white pine type. The cull per cent (exclusive of breakage) applicable to a given stand is probably best applied on an age-class basis as follows:

80 to 100 years	101 to 120 years	121 to 140 years	141 to 160 years	161 to 180 years	181 to 200 years	201 to 300 years	301+ years
3%	6%	10%	12%	16%	18%	20%	24%

PONDEROSA PINE

Less than 200 years old	200 to 300 years old	300 years old and older
2%	4%	5%

If the volume tables used for cruising are based upon gross volume of trees to an arbitrary top diameter of 6 inches, the volumes obtained should be reduced one and three per cent respectively for western white and ponderosa pine before applying the preceding cull and breakage figures.

LARCH-DOUGLAS FIR

Defect in larch averaged 13% when the gross tree volumes were computed on the basis of the volume actually utilized, and 15% when the gross tree volumes were computed to a fixed top diameter of 8 inches. Thus, in the field application of these data, larch volumes obtained by cruising trees to a fixed top diameter of 8 inches should be reduced by 15% for defect plus an additional 4% for breakage, or a total of 19%. A similar figure for Douglas fir is 8%.

The preceding cull and breakage percentage figures are only indicative of these losses in average stands. Consequently, in field application they may be either raised or lowered in accordance with the cruiser's judgment of the deviation of the stand, being cruised, from the average.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
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No. 64 June, 1934 Missoula, Montana

AN ECONOMIC TREE CLASSIFICATION FOR PONDEROSA PINE

By I. V. Anderson, Associate Forester

CONTENTS

Basis of Classification - 1

Class 1-Bull Pine young - - - - - - - - - - - - - - - - 1
Class 2-Bull Pine older - - - - - - - - - - - - - - - - 2
Class 3-Shop Type - - - - - - - - - - - - - - - - - - 2
Class 4-Select Type - - - - - - - - - - - - - - - - - 3
Class 5-Inferior Trees - - - - - - - - - - - - - - - - - 3

Illustrations of Each Tree Class - - - - - - - - - - - - - - 5
Plate I, Classes 1 and 2, Figures 1,2,3,4,5,6,7 - - - - 6
Plate II, Classes 3 and 4, Figures 8,9,10,11 - - - - - - 7
Plate III, Class 5, Club limb and leaning trees,
Figures 12, 13, 14, 15 - - - - - - - - - - - - - - - 8
Plate IV, Class 5, Wolf tree, Figures 16,17,18 - - - - - 9

Notes on Trees Shown in Illustrations - - - - - - - - - - - - 10

Plate I, Figure 1 - - - - - - - - - - - - - - - - - - - 10
Figures 2 and 3 - - - - - - - - - - - - - - - - 11
Figures 4, 5 and 6 - - - - - - - - - - - - - - - 12
Figure 7 - - - - - - - - - - - - - - - - - - - 13

Plate II, Figure 8 - - - - - - - - - - - - - - - - - - 13
Figures 9 and 10 - - - - - - - - - - - - - - - 14
Figure 11 - - - - - - - - - - - - - - - - - - 15

Plate III, Figures 12 and 13 - - - - - - - - - - - - - - 16
Figures 14 and 15 - - - - - - - - - - - - - - 17

Plate IV, Figures 16 and 17 - - - - - - - - - - - - - - 18
Figure 18 - - - - - - - - - - - - - - - - - - 19

BASIS OF CLASSIFICATION

Ponderosa pine trees are quite readily classified according to the predominating grade of lumber produced from the tree. There are a number of factors affecting the quality of lumber produced from a given tree such as; age, position in the stand, size, amount of defect and quality of site. That age exerts the greatest and most uniform influence on grade of lumber produced as has been demonstrated by a recent selective logging study in western Montana. Therefore this factor has been used as the principal basis in the determination of economic tree grades.

This classification is based on the analysis of 231 trees, which is probably not a sufficient number to give results significant of the average stand conditions throughout the Inland Empire. Therefore, they should be considered as preliminary and subject to revision as additional data are gathered. They do, however, constitute an excellent guide for the selection of profitable trees in the stand, and should be of material benefit to lumbermen who desire to practice economic selective logging. Studies have shown that this type of logging more than satisfies that requirement of Article 10 of the Lumber Code which provides for regrowth on cut-over lands.

CLASS 1 - BULL PINE - YOUNG

Age, usually not over 120 years old, but occasionally up to 160 years old; Lumber Production, produce from 50% to 80% of #2 common lumber; Size, seldom over 18 inches d.b.h.; Dunning Tree Class, usually class 1 and 2 and rarely class 4; Branching Habit, dead and green branches usually mixed from breast height to top of first log, mostly green branches from this point and upward.

Trees that are characterized as young bull pine invariably fall in this class. The bark is always dark brown, usually quite deeply grooved, and without pronounced plates. In proportion to their tree volume they produce more #2 common lumber (sometimes a small amount of #1 common) than any other tree class.

CLASS 2 - BULL PINE - OLDER

Age, usually not over 250 years old; Lumber Production, produce from 50% to 80% of #3 common and poorer lumber including #3 shop and inch shop; Size, rarely under 18 inches in size and seldom over 30 inches d.b.h.; Dunning Tree Class, usually class 3 or 4 and sometimes 2; Branching Habit, numerous small to medium-sized dead spike branches persistent on top half or two-thirds of butt log extending up trunk to green branches.

These trees are usually characterized as just coming out of the bull pine stage. The bark is rather dark brown without pronounced plates and usually quite deeply grooved. In general appearance they possess fair to good vigor in spite of the numerous dead spike branches on the lower part of the bole.

CLASS 3 - SHOP TYPE

Age, always mature or overmature over 300 years of age; Lumber Production, yield from 25% to 40% of shop lumber (all grades); with lesser amounts of D and better select; Size, rarely under 26 inches in d.b.h.; Dunning Tree Class, usually class 5 but sometimes class 3 or 4; Branching Habit, large coarse branches, spike or green, sometimes appearing as low as the upper end of first log and spaced to permit manufacture of shop lumber.

The shop type of tree occurs less frequently in the average ponderosa pine stand of western Montana than any of the economic tree grades. The production of select is always less than the shop lumber production, and the yield of #1 and #2 common is always negligible. Three common and poorer lumber sometimes constitutes over 50% of the lumber yield of the tree.

CLASS 4 - SELECT TYPE

Age, usually mature or overmature over 300 years of age, but sometimes includes younger trees grown under highly competitive root and crown competition; Lumber Production, ordinarily produce from 20 to 40% of select lumber (all grades) with lesser amounts of shop lumber; Size, seldom under 20 inches d.b.h. except on poorest sites; Dunning Tree Class, most frequently classes 4 and 5 and sometimes classes 3 and 7; Branching Habit, one to two logs usually surface clear and free from limbs, green and dead spike limbs, closely spaced precluding the production of any material amount of shop lumber.

Occasionally overmature suppressed or intermediate trees under 20 inches d.b.h. are included in this class. Likewise a tree containing an excessive amount of hidden defect may be classified as a select tree in error. Three common and poorer lumber frequently constitute 50% or more of the lumber yield of the tree in addition to the select lumber produced.

CLASS 5 - INFERIOR TREES

Age, usually mature or overmature but may be any age; Lumber Production, invariably over 75% of #3 common and poorer with considerable amount of #5 common in defective trees; Size, may be any size; Dunning Tree Class, usually classes 4, 5 and 7 but may be any class.

Utilization of this class of trees for lumber is not profitable. They include four types of trees, excessively defective trees, sound trees of inherently poor quality (club limb), wolf trees and leaning trees. The latter type cannot be definitely considered as always inferior, but results of a recent selective logging study indicate that they are invariably of low quality. Quite frequently excessively defective trees that are nonprofitable contain no outward indications of defect and are very difficult to identify without felling. Therefore, they have not been included in the illustrations that follow.

- - - - - - - - - - -

The Dunning Tree Classes mentioned in the preceding specifications for Economic Tree Classes were developed by Duncan Dunning of the United States Forest Service. Silvicultural characteristics of the individual tree are the basis used in this classification for segregating into groups ponderosa pine trees possessing similar combinations of characteristics. Seven classes of trees are recognized. A detailed description of these tree classes is contained in a reprint entitled "A Tree Classification For The Selection Forests of The Sierra Nevada," Journal of Agricultural Research, Volume 36, Number 9. Copies may be obtained from the Office of Information, United States Department of Agriculture, Washington, D. C.

ILLUSTRATIONS
OF
EACH TREE CLASS

PLATE I

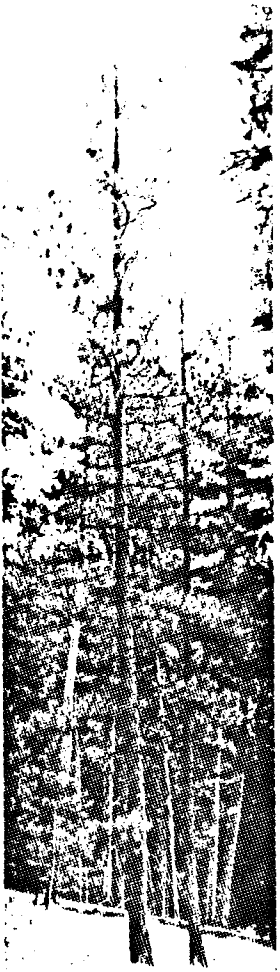

FIG. 1 CLASS 1
YOUNG BULL PINE

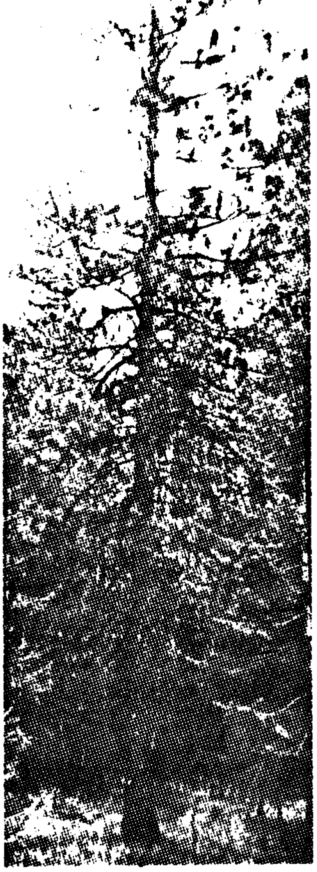

FIG. 2 CLASS 1

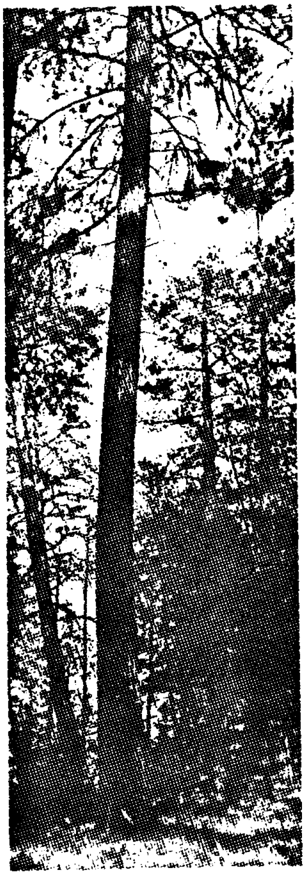

FIG. 3 CLASS 2
OLDER BULL PINE

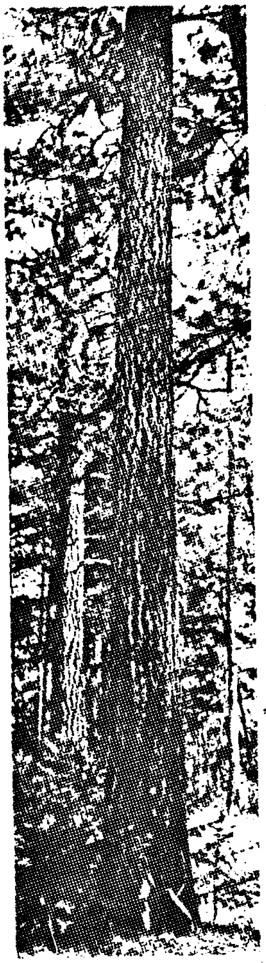

FIG. 4 CLASS 2

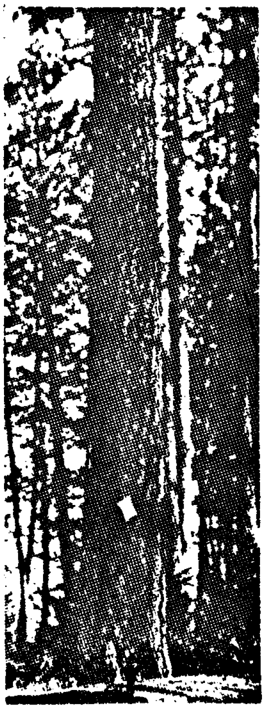

FIG. 5 CLASS 2

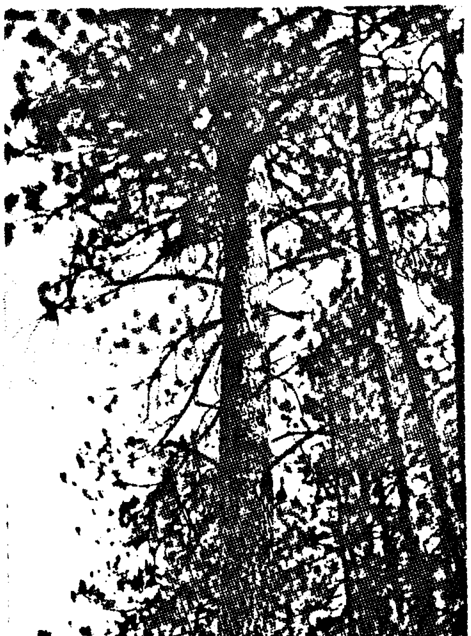

FIG. 6 CLASS 2

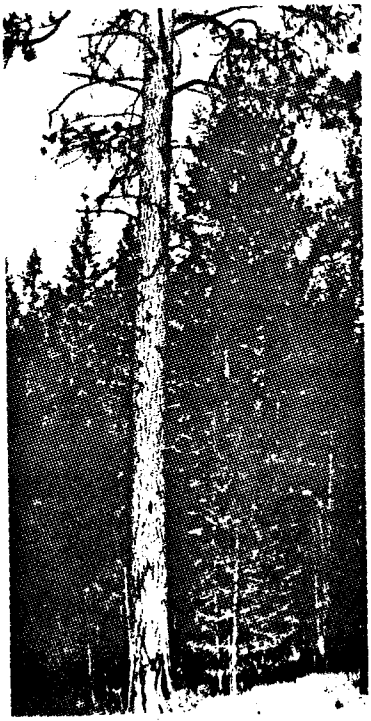

FIG. 7 CLASS 2

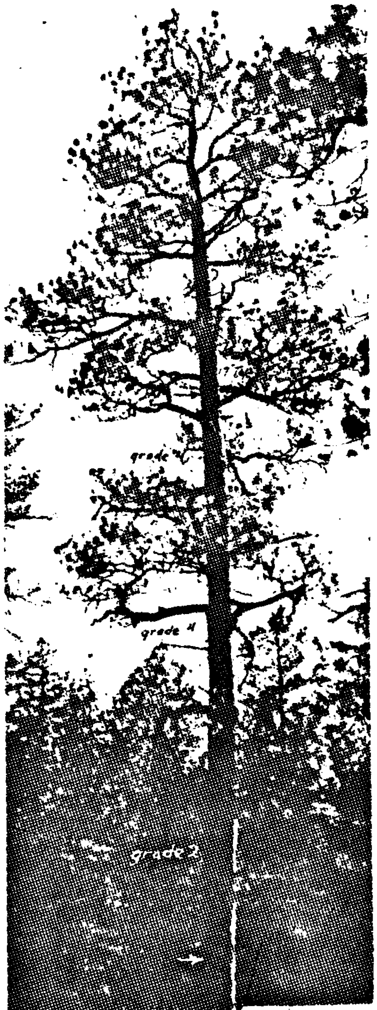
grade 4
grade 2

FIG. 8 CLASS 3
SHOP TYPE

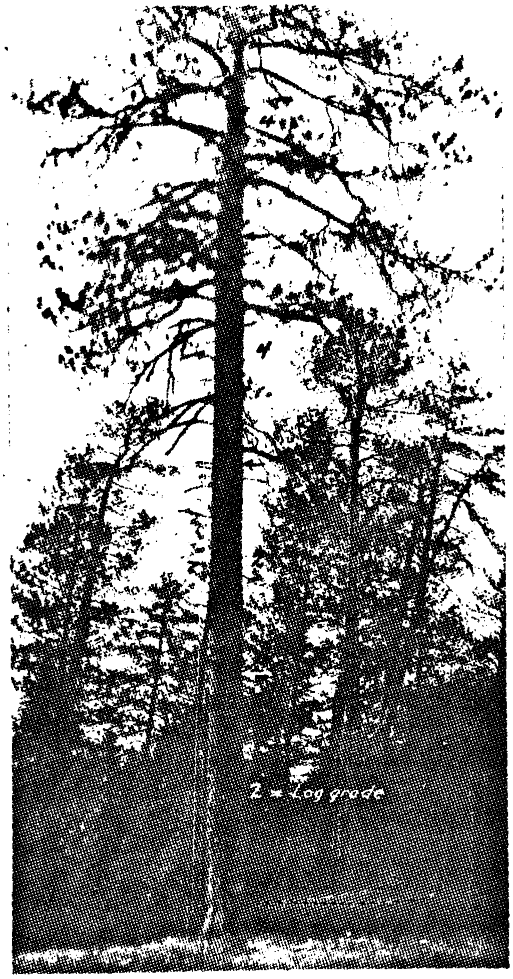
4
2 = Log grade

FIG. 9 CLASS 3

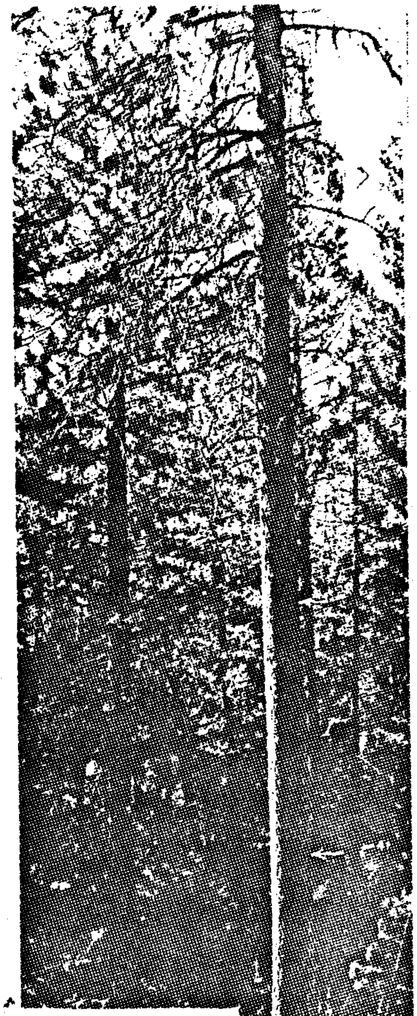

FIG. 10
CLASS 4
SELECT TYPE

PLATE II

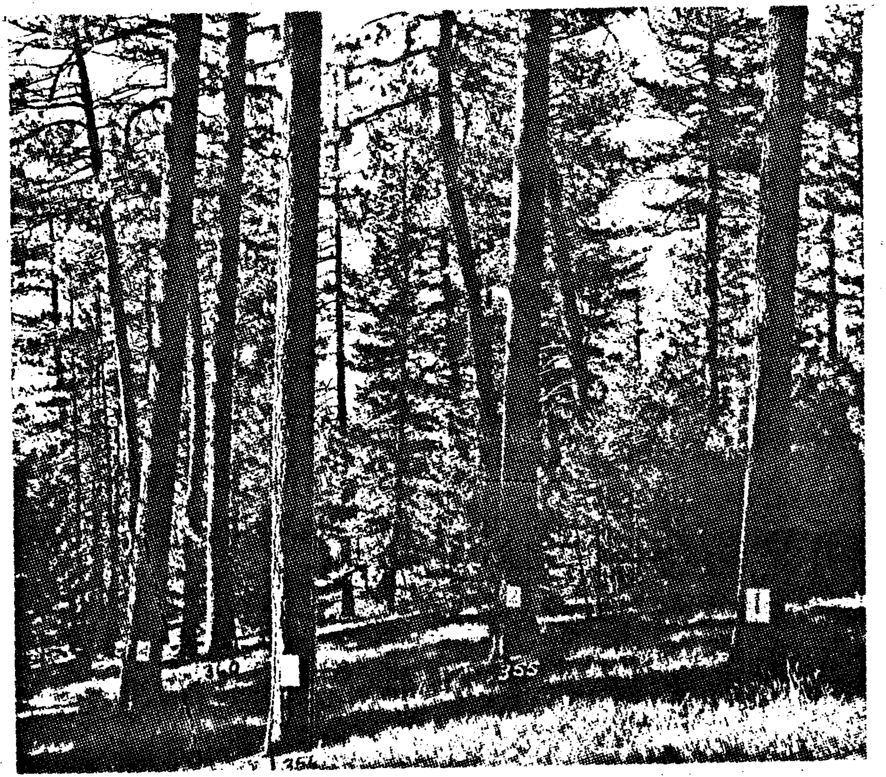

FIG. 11 CLASS 3 & 4

PLATE III

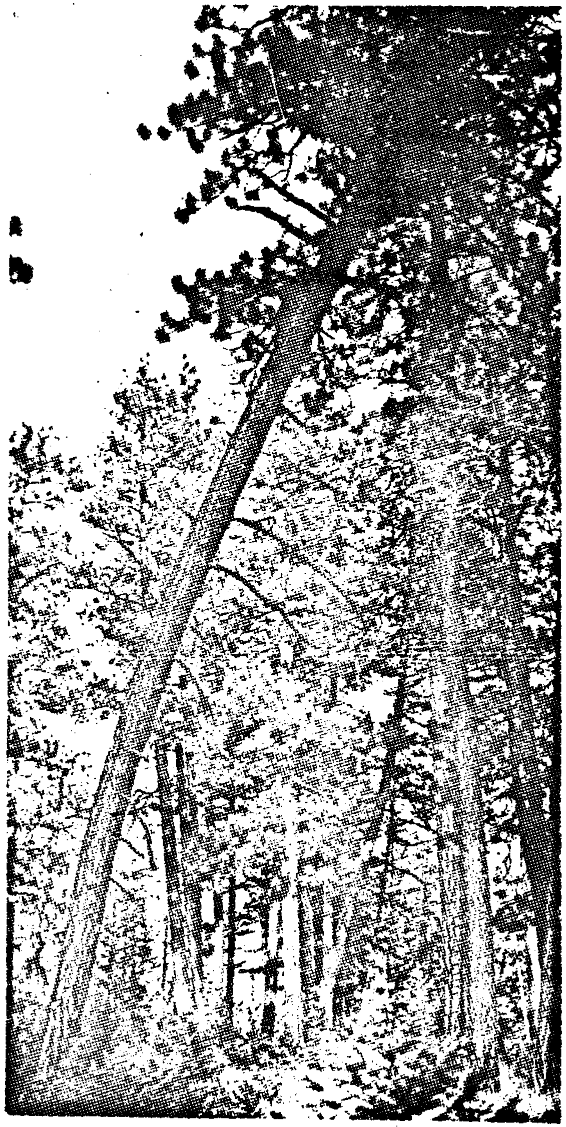

FIG. 12 CLASS 5

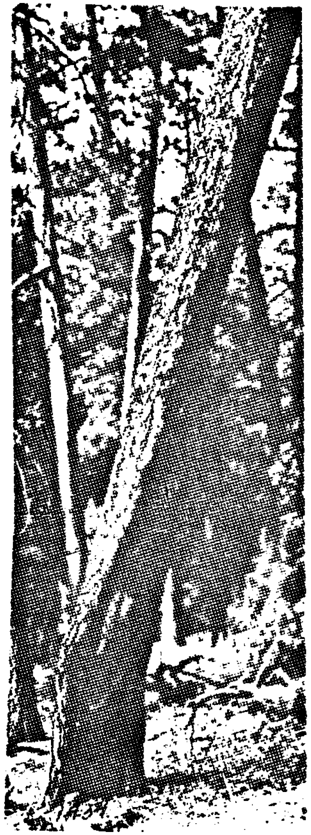

FIG. 13 CLASS 5
LEANER

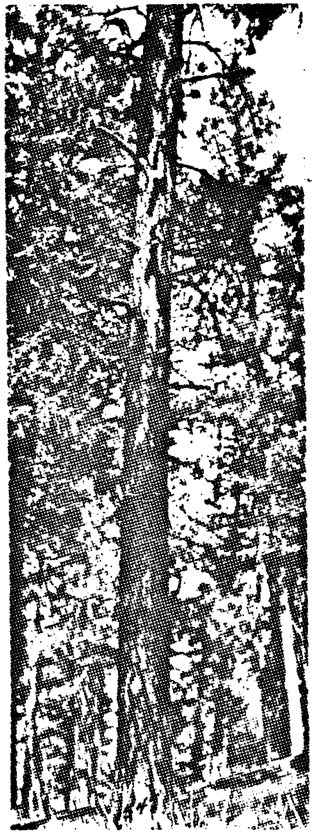

FIG. 14 CLASS 5
CLUB LIMB

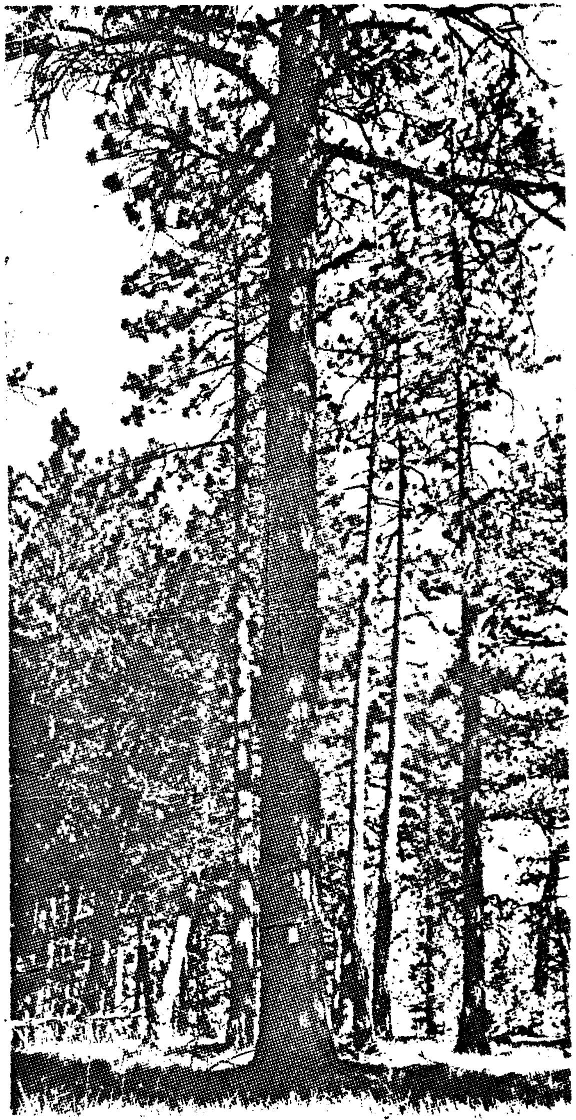

FIG. 15 CLASS 5
CLUB LIMB

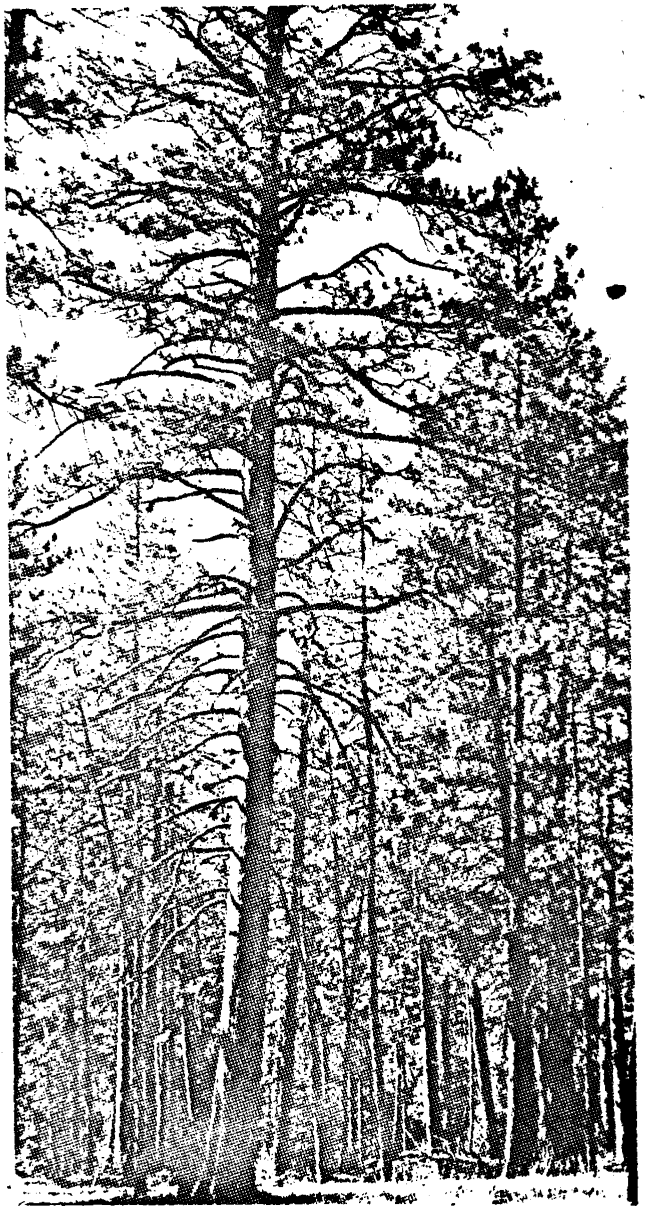

FIG. 16 CLASS 5
WOLF TREE

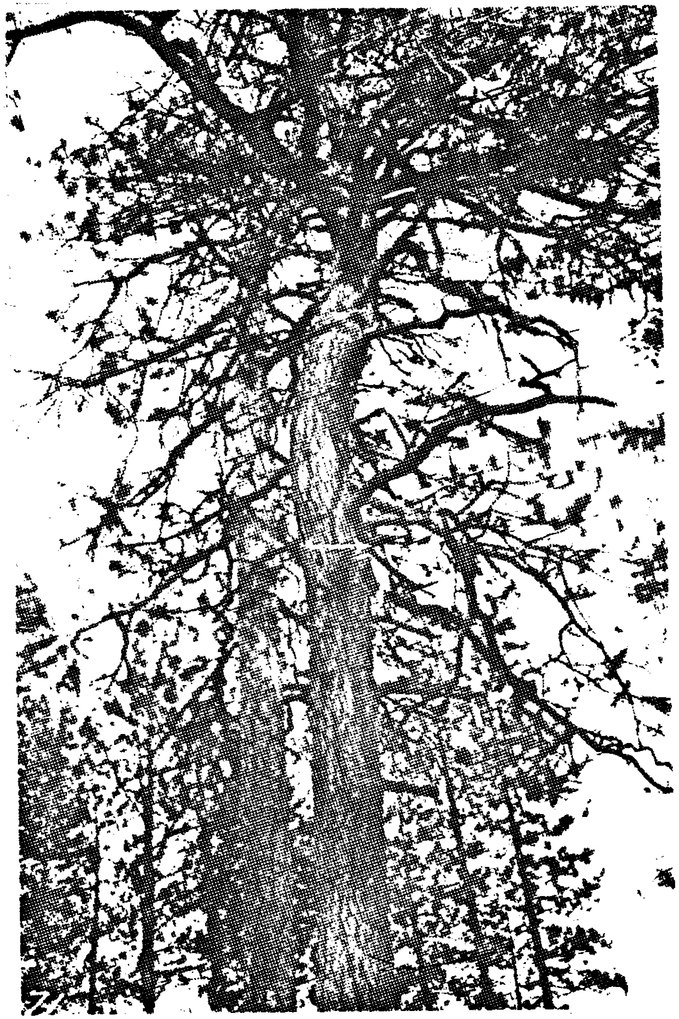

FIG. 17

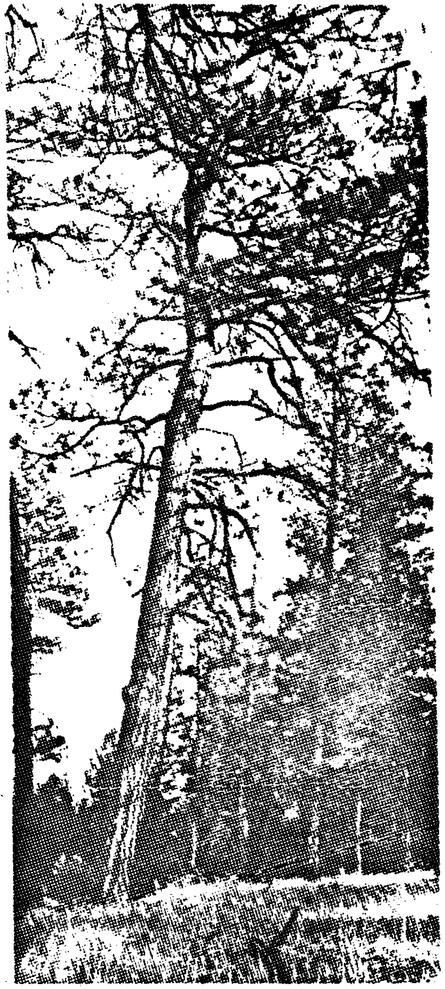

FIG. 18

PLATE IV

NOTES ON TREES SHOWN IN ILLUSTRATIONS

The production costs shown in the following notes were secured from a typical ponderosa pine operation in western Montana. They are as representative of operating costs under the Lumber Code as is possible to obtain at this time. Lumber selling values were obtained by applying Code prices effective January 1, 1934, to a piece tally by grades and sizes of the lumber cut from each tree.

PLATE I

Figure 1

Class 1 tree, bull pine - young.

Age 110 years. D.B.H.[1] 14 inches. Dunning Class #1.
Top Utilization 9 inches.

Production cost per M lumber tally	$25.48	Per tree	$3.16
Selling value " " " "	23.83	" "	2.96
Loss " " " "	1.65	" "	.20

Log Description			Log Scale Bd. Ft.				Lumber Yield				
Place in Tree	Lgth. Ft.	Grade[2] E.L.A.	Gross	Defect Amt.	Defect Cause[3]	Net	Total in Bd.Ft	Per Cent by Grades Common 1	2	3	4
Butt	16	3 3	70	10		60	61	0	92	5	3
Top	16	3 3	40	0		40	63	13	81	0	6
All			110	10		100	124	6	87	2	5

Pointed top, codominant, vigor good. Limbs begin at point 5 feet from ground. Bark dark. Length of bole to first dead limb 5 feet, to first green limb 8 feet.

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[1] D.B.H. = diameter at breast height.

[2] E = log grade estimated in standing tree, L = log grade assigned at railroad landing, A = actual log grade as determined by lumber yield.

[3] FS = fire scar, HR = heart rot, CK = crook, MP = mass pitch.

Figure 2

Class 1 tree, bull pine - young.

Age 106 years. D.B.H. 17 inches. Dunning Class #1.
Top Utilization 8 inches.

Production cost	per M lumber tally	$22.54		Per tree	$5.32
Selling value	" " " "	19.57		" "	5.05
Loss	" " " "	2.97		" "	.27

Log Description			Log Scale Bd. Ft.				Lumber Yield				
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect Amt.	Defect Cause	Net	Total	Per Cent by Grades: Select D	Common 2	Common 3	Common 4
Butt	16	3 4	100	0		100	123	3	11	82	4
2nd	16	4 3	70	0		70	95	0	83	17	0
Top	16	4 3	30	0		30	40	0	93	7	0
All			200	0		200	258	1	50	47	2

Dominant, vigor fair, bark dark. Length of bole to first dead branch 4 feet, to first green limb 9 feet. Girdled by porcupine at top d.i.b. of 6".

Figure 3

Class 2 tree, bull pine - older

Age 185 years. D.B.H. 25 inches. Dunning Class #2.
Top Utilization 11 inches.

Production cost	per M lumber tally	$18.64		Per tree	$11.09
Selling value	" " " "	19.30		" "	11.48
Gain	" " " "	.66		" "	.39

Log Description			Log Scale Bd. Ft.				Lumber Yield					
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect Amt.	Defect Cause	Net	Total in Bd.Ft.	Per Cent by Grades: Select C	Select D	Common 2	Common 3	Common 4
Butt	16	3 3 4	180	40		140	210	0	6	6	78	10
2nd	16	3 3 3	160	0		160	171	6	0	32	62	0
3rd	16	3 3 3	110	0		110	127	0	0	61	36	3
Top	14	3 3	50	0		50	87	0	0	51	49	0
All			500	40		460	595	2	2	32	60	4

Dominant, vigor fair, dark bark. Small pin knots 1/2" in diameter beginning at point on bole 3 feet from ground and extending upward.

Figure 4

Close-up view of butt log of tree shown in Figure 3. Note small pin knots responsible for production of 3 common lumber in butt logs of trees in class 2.

Figure 5

Class 2 tree, bull pine - older.

Age 216 years. D.B.H. 23 inches. Dunning Class 4.
Top Utilization 14 inches.

Production cost per M lumber tally	$21.83	Per tree $13.39
Selling value " " " "	18.28	" " 11.21
Loss " " " "	3.55	" " 2.18

Log Description			Log Scale Bd. Ft.				Lumber Yield						
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect		Net	Total in Bd.Ft.	Per Cent by Grades					
				Amt.	Cause			Select		Shop	Common		
								C	D	3&4/4	2	3	4
Butt	16	2 3 4	210	10	FS	200	242	2	22	0	0	74	2
2nd	20	3 3 4	220	20	HR	200	246	0	0	28	0	51	21
Top	16	3 3 4	110	20	HR	90	125	0	2	12	0	65	21
All			540	50		490	613	1	9	14	0	63	13

Dominant, round top, vigor fair, bark faded, grooves not deep, bark beginning to flake taking on almost faded look. Typical small to medium spike knots.

Figure 6

Shows upper part of tree in Figure 5. Note the close branching habit of this tree which indicates why this tree produced 63% of 3 common and 13% of 4 common lumber, or 76% of both.

Figure 7

Class 2 tree, bull pine - older.

Age 235 years. D.B.H. 29 inches. Dunning Class #3.
Top Utilization 17 inches.

Production cost	per M	lumber	tally	$18.41	Per	tree	$25.93
Selling value	"	"	"	14.75	"	"	20.78
Loss	"	"	"	3.66	"	"	5.15

Log Description			Log Scale Bd. Ft.				Lumber Yield								
Place	Lgth.	Grade	Gross	Defect		Net	Total	Per Cent by Grades							
in	Ft.			Amt.	Cause		in	Select		Shop		Common			
Tree		E.L.A.					Bd.Ft	C	D	2	3&4/4	2	3	4	5
Butt	16	4 3 4	400	0		400	441	1	9	0	26	0	25	35	4
2nd	16	3 3 3	330	0		330	387	0	4	10	24	21	23	18	0
3rd	16	3 4 4	280	0		280	344	0	0	0	4	32	0	64	0
Top	16	0 4 4	180	0		180	236	0	0	0	3	0	59	38	0
All			1190	0		1190	1408	0	4	3	17	13	24	38	1

Note how persistent and numerous the spike branches are on upper part of butt log. Dominant, vigor fair, bark dark, number of spikes on tree 60. Length of bole to first dead spike 12 feet, to first green limb 39 feet. One-third of stump area showed mass pitch.

PLATE II

Figure 8

Class 3 tree - shop type.

Age 430 years. D.B.H. 33 inches. Dunning Class #5.
Top Utilization 17 inches.

Production cost	per M	lumber	tally	$17.29	Per	tree	$26.00
Selling value	"	"	"	24.25	"	"	36.46
Gain	"	"	"	6.96	"	"	10.46

Log Description			Log Scale Bd. Ft.				Lumber Yield								
Place	Lgth.	Grade	Gross	Defect		Net	Total	Per Cent by Grades							
in	Ft.			Amt.	Cause		in	Select			Shop		Common		
Tree		E.L.A.					Bd.Ft.	B	C	D	1&2	3&4/4	3	4	5
Butt	16	4 1 1	550	50	FS HR	500	394	1	2	27	24	21	12	13	0
2nd	16	1 1 1	500	20	CK	480	461	0	10	16	41	7	9	17	0
3rd	16	3 2 2	330	30		300	275	0	0	2	46	5	33	14	0
4th	12	0 2 4	180	60	HR	120	209	0	1	8	9	10	26	35	11
Top	12	0 4 4	140	30	HR	110	165	0	0	0	0	4	2	94	0
All			1700	190		1510	1504	0	4	13	28	11	11	31	2

Dominant, poor vigor, faded bark, 25 feet to first dead limb and 38 feet to first green limb, fire scar 5 feet up. Coarse limbed and open angular branching habit. The two top logs would not be taken under economic selection. Without these the tree would have yielded 36% of 1&2 shop.

Figure 9

Class 3 tree, shop type.

Age 367 years. D.B.H. 33 inches. Dunning Class #5.
Top Utilization 15 inches.

Production cost	per M lumber tally	$17.29		Per tree		$39.10
Selling value	" " " "	21.47		"	"	48.54
Gain	" " " "	4.18		"	"	9.44

Log Description			Log Scale Bd. Ft.				Lumber Yield							
Place	Lgth.	Grade	Gross	Defect		Net	Total	Per Cent by Grades						
in	Ft.			Amt.	Cause		in	Select		Shop		Common		
Tree		E.L.A.					Bd.Ft	C	D	1&2	3&4/4	2	3	4
Butt	16	1 1 2	580	0		580	607	1	17	33	8	5	30	6
2nd	16	2 1 2	550	0		550	571	1	9	49	8	11	22	0
3rd	16	4 4 4	460	0		460	529	1	2	7	26	0	38	26
4th	16	0 4 4	330	10		320	351	0	1	6	4	0	14	75
Top	16	0 4 4	140	10		130	203	0	0	0	0	0	30	70
All			2060	20		2040	2261	1	7	24	11	4	27	26

Dominant, fair vigor, orange bark, 42 spike limbs. Length of bole to first dead limb 15 feet, to first live limb, 34 feet. Log 3 was a pay log due to its size. Logs 4 and T would be eliminated under economic selection.

Figure 10

Class 4 tree, select type.

Age 345 years. D.B.H. 30 inches. Dunning Class #5.
Top Utilization 16 inches.

Production cost	per M lumber tally	$19.71		Per tree		$24.30
Selling value	" " " "	22.71		"	"	28.00
Gain	" " " "	3.00		"	"	3.70

Log Description			Log Scale Bd. Ft.				Lumber Yield								
Place	Lgth.	Grade	Gross	Defect		Net	Total	Per Cent by Grades							
in	Ft.			Amt.	Cause		in	Select			Shop		Common		
Tree		E.L.A.					Bd.Ft	B	C	D	1&2	3&4/4	2	3	4
Butt	16	3 3 1	380	50	FS	330	386	10	27	16	0	4	2	29	12
2nd	16	3 3 3	300	0		300	354	0	5	16	8	10	5	37	19
3rd	14	3 3 4	210	0		210	259	0	0	0	7	5	0	45	43
Top	18	4 4 3	200	0		200	234	0	2	0	0	0	0	58	40
All			1090	50		1040	1233	3	10	10	4	5	2	42	24

Dominant, fair vigor, round top. Mass pitch 25% of stump area. Bark bright orange, narrow plates, moderately deep grooves. Length of bole to first dead and green limb 17 feet and 48 feet. Three and one-half-foot fire scar. Branches small, crown wide and medium long.

Figure 11

Class 4 tree, select type.
Tree number 330, extreme right of group.

Age 262 years. D.B.H. 21 inches. Dunning Class #7.
Top Utilization 12 inches.

Production cost per M lumber tally	$20.17	Per tree	$ 9.64
Selling value " " " "	25.50	" "	12.19
Gain " " " "	5.33	" "	2.55

Log Description			Log Scale Bd. Ft.				Lumber Yield						
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect Amt.	Defect Cause	Net	Total in Bd.Ft	Per Cent by Grades Select C	D	Shop 3&4/4	Common 2	3	4
Butt	16	1 1 1	160	0		160	193	20	19	1	27	33	0
2nd	16	1 1 1	140	0		140	168	12	34	2	26	24	2
Top	16	4 4	80	20		60	117	0	0	0	0	73	27
All			380	20		360	478	12	20	1	20	40	7

Intermediate, flat top, fair vigor, only 6 spike limbs on tree. Length of bole to first dead limb 33 feet, to first green limb 33 feet. A good example of a tree that was pruned early in life, surrounded by 5-log trees.

Figure 11

Class 4 tree, shop type.
Tree number 357 or card 4.

Age 280 years. D.B.H. 31 inches. Dunning Class #5.
Top Utilization 19 inches.

Production cost per M lumber tally	$17.64	Per tree	$34.76
Selling value " " " "	23.78	" "	46.86
Gain " " " "	6.14	" "	12.10

Log Description			Log Scale Bd. Ft.				Lumber Yield							
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect Amt.	Defect Cause	Net	Total in Bd.Ft	Per Cent by Grades Select C	D	Shop 1&2	3&4/4	Common 2	3	4
Butt	16	1 1 1	550	0		550	522	16	28	0	14	6	27	9
2nd	16	1 1 2	500	0		500	492	9	9	24	7	7	41	3
3rd	16	2 1 2	400	0		400	453	0	15	33	6	3	25	18
4th	14	4 2 4	270	0		270	293	0	4	0	27	0	49	20
Top	12	4 4	180	0		180	211	0	0	0	10	0	54	36
All			1900	0		1900	1971	7	13	14	12	4	36	14

Dominant, poor vigor, orange bark, 10 spike limbs. Length of bole to first dead limb 10 feet, to first live limb 45 feet. Note wide spacing of spike branches on 2nd log necessary for production of shop lumber. Log No. 4 in this tree was a pay log on account of its size. A fair example of a shop tree.

PLATE III

Figure 12

Class 5 tree, inferior, "leaner."

Age 325 years. D.B.H. 20 inches. Dunning Class #4.
Top Utilization 9 inches.

Production cost per M lumber tally	$20.51	Per tree $8.47
Selling value " " " "	13.87	" " 5.73
Loss " " " "	6.64	" " 2.74

Log Description			Log Scale Bd. Ft.				Lumber Yield						
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect Amt.	Defect Cause	Net	Total in Bd.Ft	Per Cent by Grades: Select C	Select D	Common 2	Common 3	Common 4	Common 5
Butt	16	4 4	180	120	HR	60	156	0	8	4	6	82	0
2nd	16	4 4	160	120	HR	40	85	0	0	0	0	68	32
3rd	16	4 4	100	880	HR	20	125	4	0	0	2	35	59
Top	14	4 4	30	20	HR	10	47	0	0	11	89	0	0
All			470	340		130	413	1	3	3	13	56	24

Codominant, fair vigor, dark colored bark. Leans badly for no apparent reason. No fire scar evident at butt. Length of bole to first dead limb 7 feet, to first green limb 35 feet. Ten-and 12-foot lumber cut from top log to eliminate defect.

Figure 13

Class 5 tree, inferior, "leaner."

Age ? . D.B.H. 25 inches. Dunning Class #5.
Top Utilization 14 inches.

This tree was skidded to the landing, bucked to three 14-foot logs and discarded as a cull. It leaned 40° uphill from vertical. The butt was badly fire scarred and crooked and the bole twisted and distorted, indicating spiral grain. The fire scar extended 8 feet up the butt log.

Figure 14

Class 5 tree, inferior "club limb."

Age 289 years. D.B.H. 24 inches. Dunning Class #3.
Top Utilization 13 inches.

Production cost per M lumber tally	$21.18	Per tree	$19.92
Selling value " " " "	18.17	" "	17.10
Loss " " " "	3.01	" "	2.82

Log Description			Log Scale Bd. Ft.				Lumber Yield					
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect		Net	Total in Bd.Ft.	Per Cent by Grades				
				Amt.	Cause			Select D	Shop 3&4/4	Common 2	Common 3	Common 4
Butt	16	1 4	280	0		280	312	3	14	15	64	4
2nd	16	4 4	210	0		210	266	0	4	6	60	30
3rd	16	4 4	180	0		180	207	0	4	24	46	26
Top	16	4 4	100	0		100	156	0	0	17	60	23
All			770	0		770	941	1	7	15	58	19

Originally reserved for seed tree, but cut by mistake by sawyers. Horn limbs from upper half of butt log and upward. Length of bole to first dead and green limb 8 feet and 22 feet, respectively. Crown was dominant and showed good vigor.

Figure 15

Class 5 tree, inferior "club limb."

Age 273 years. D.B.H. 28 inches. Dunning Class #5.
Top Utilization 22 inches.

Production cost per M lumber tally	$20.78	Per tree	$18.11
Selling value " " " "	17.39	" "	15.16
Loss " " " "	3.39	" "	2.95

Log Description			Log Scale Bd. Ft.				Lumber Yield						
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect		Net	Total in Bd.Ft.	Per Cent by Grades					
				Amt.	Cause			Select C	Select D	Shop 2	Shop 4/4	Common 3	Common 4
Butt	16	2 3 4	380	20	FS	360	402	1	5	15	14	9	56
2nd	20	4 4 4	420	0		420	470	1	3	7	26	37	26
All			800	20		780	872	1	4	11	20	24	40

Note persistent spike limbs. Length of bole to first dead spike 4 feet, to first green limb 37 feet. Dominant, poor vigor, orange bark and 40 spike limbs on tree.

PLATE IV

Figure 16

Class 5 tree, inferior, "wolf."

Age 316 years. D.B.H. 36 inches. Dunning Class #5.
Top Utilization 29 inches.

Production cost per M lumber tally	$21.36	Per tree $16.83
Selling value " " " "	17.06	" " 13.44
Loss " " " "	4.30	" " 3.39

Log Description			Log Scale Bd. Ft.				Lumber Yield					
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect		Net	Total in Bd.Ft.	Per Cent by Grades				
				Amt.	Cause			Select		Shop	Common	
								C	D	3&4/4	3	4
Butt	20	1 1 4	790	80	MP FS	710	788	2	5	10	29	54

Typical overmature stage of wolf tree. Stump contained 80% mass pitch. Considered very questionable at time of cutting but taken to see what it would produce. Dominant, poor vigor, orange bark, 40 spike limbs, 10 feet to lowest dead limb and 36 feet to lowest green limb. Cut 93% of 3 common and poorer.

Figure 17

This illustration shows a deformed tree that was questionable from a utilization standpoint.

Age 420 years. D.B.H. 29 inches. Dunning Class #5.
Top Utilization 24 inches.

Production cost per M lumber tally	$20.45	Per tree $13.50
Selling value " " " "	26.00	" " 17.15
Gain " " " "	5.55	" " 3.65

Log Description			Log Scale Bd. Ft.				Lumber Yield							
Place in Tree	Lgth. Ft.	Grade E.L.A.	Gross	Defect		Net	Total in Bd.Ft.	Per Cent by Grades						
				Amt.	Cause			Select			Shop		Common	
								B	C	D	1&2	3&4/4	3	4
Butt	12	1 1 1	340	40	HR CK	300	340	5	11	34	4	0	31	15
Top	12	2 1 2	300	20	MP CK	280	320	0	0	3	27	15	11	44
All			640	60		580	660	2	6	19	15	8	21	29

Originally figured to cut one log. When felled it was decided to cut two 12-foot logs. Line indicates where top cut came. Codominant, poor vigor, orange bark and 20 spike limbs. Carbuncle on side of trunk. Lumber contained considerable compression wood. Length of bole to first dead and green limb was 16 feet and 29 feet, respectively.

Figure 18

This shows detail of branch arrangement at the top of the second log of the tree in Figure 17. Note the knot arrangement of the second log that was responsible for the production of 27% of 1&2 shop lumber.

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No. 65 July, 1934 Missoula, Montana.

Paired Minimum Temperatures As Indices of Fair or Foul Weather

by
H. T. Gisborne, Silviculturist.

In April, 1933, the attention of Region One Forest officers was called to a simple method of determining the possibility of unsettled weather, including lightning storms. This method is not infallible and best results are obtained only during July and August, yet any simple process that assists in estimating either the possibility of lightning or the probability of fair weather can be used in this Region to get better forest fire control at less cost.

The present method is based on the principle that warm air rises into a colder layer above it, thereby creating what is called a convectional storm. Such a flow of air always increases the wind velocity, and if the warm air has a high moisture content this moisture is condensed when it reaches the colder layer aloft, thereby forming clouds which may, if sufficiently turbulent, generate lightning and/or precipitation. A study of weather records for pairs of adjacent stations at high and low elevations, such as a lookout station and a ranger station not more than 10 or 12 miles away, showed that the minimum temperatures at these pairs of stations can be used dependably to indicate the probability of fair or foul weather each day. This study showed the best dependability for July and August, but forecasts based on comparisons of minimum temperatures during June, 1934, have also been quite accurate, as shown.

The method of comparing these minimum temperatures is indicated by the tabulation of the records for Elk Mountain Lookout (elevation 5348) and Bungalow Ranger Station (elevation 2250) on the Clearwater National Forest. As shown in this tabulation, when the minimum at the lookout is lower than the minimum at the ranger station, unsettled weather is indicated. When the ranger station has the lower minimum, fair weather is most likely to occur in that icinity that day.

Sample of Forecasts Based on Paired Minimum Temperatures

Date	Minimum Temperature in Morning Elk Mtn.	Minimum Temperature in Morning Bungalow	Difference	Forecasts Based on Difference°	Actual Weather
1	35	46	–	Unsettled	Rain
2	34	40	–	"	"
3	42	49	–	"	Thunderstorms
4	39	49	–	"	Unsettled
5	41	40	+	Fair	Thunderstorms
6	43	46	–	Unsettled	Rain
7	42	49	–	"	"
8	40	48	–	"	"
9	48	49	–	"	Fair
10	54	49	+	Fair	"
11	57	50	+	"	"
12	60	58	+	"	"
13	55	49	+	"	"
14	53	46	+	"	"
15	50	46	+	"	"
16	45	42	+	"	"
17	48	43	+	"	"
18	49	52	–	Unsettled	Unsettled
19	41	42	–	"	Fair
20	43	42	+	Fair	"

° + indicates fair, - indicates unsettled weather.

This record for early June contains 10 forecasts of unsettled weather, of which two are in error, thereby showing 80% dependability. Of the 10 forecasts of fair weather, only one was wrong, showing 90% dependability. This greater dependability in indicating fair weather was also found by the original investigation of the records for three pairs of stations. That investigation showed a dependability of 84% for unsettled forecasts, and 91½% for fair weather forecasts during July and August.

Standard minimum thermometers should be used for this work, each properly exposed either in a standard meteorological instrument shelter or in a well ventilated box that shields the thermometer from both rain and sunshine. The usual exposure of the instrument is about 4½ feet above the ground. The thermometers cost about $3.35 each when obtained through the Forest Service.

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Technical Note No. 66. July, 1934. Missoula, Montana.

OVERGRAZING REDUCES CATTLE GAINS AND INCREASES PRODUCTION COSTS

By

Leon C. Hurtt, Associate Range Examiner.

Nothing is more vital to the range livestock grower to-day than the problem of reducing production costs below the present and prospective selling prices. A project, Management of Short Grass Ranges, started by the U. S. Forest Service at Miles City two years ago in co-operation with the Bureau of Animal Industry and the Montana Agricultural Experiment Station, has already yielded preliminary data of interest to range users seeking ways of reducing production costs. The following table shows how three lots of cattle, each with 20 young purebred Hereford cows of uniform age, breeding and conformation and of almost equal weight in the beginning, responded to different grazing intensities. The cows spend alternate periods of six months on adjacent sets of carefully controlled winter and summer pastures. The size of the pastures is such that Lot 1 overgrazes its range, Lot 2 uses its range with moderation, normally leaving a substantial amount of less choice forage, while Lot 3 grazes lightly and leaves about 25% of even the better forage plants.

Table 1. Influence of Grazing Intensity on Cattle Weights and Range Costs

Grazing intensity	Acres per cow year-long	Av.Wt.of 1933 Calves°			Cows av. gain or loss July 1932 to Nov. 1933	Av. lbs. produced cow plus calf in 1½ years	Range costs per lb.. gain @ 15¢ per A.°°
		At birth April May	At weaning Oct.18 1933	Pro-rated to 20 cows			
Over-grazed Lot 1	23.1	(18) 69.4	(18) 295.3	264.0	-6.4	257.6	1.34¢
Moderately grazed Lot 2	30.5	(20) 73.3	(19) 319.0	303.0	69.3	372.3	1.22¢
Lightly grazed Lot 3	38.8	(17) 72.9	(17) 324.1	275.5	91.5	367.0	1.58¢
Average Lots 2 and 3	34.6	(37) 73.1	(36) 321.4	289.2	80.4	369.6	1.40¢

° Number of calves per lot given in parenthesis.
°° Range costs are for 1½ years at 10 cents per acre, per year.

Only the range cost is included in the last column above, as other costs were the same for all lots. These range costs of 10 cents per acre per year, or 15 cents for the 1½ years of the test, are slightly above the present average lease price, exclusive of fencing costs, for range in the Miles City region. This 15 cents is, however, substantially below the cost of grazing based on taxes and interest alone of such privately owned grazing land purchased at a price of $2 or more per acre.

After paying 15 cents per acre for the extra range used by cows of Lot 2 their average weight gain of 372.3 pounds is, at 4 cents per pound, worth $3.48 more on a per head basis than the 257.6 pounds gain of cows on overgrazed range in Lot 1 during a period of 1½ years. This is equivalent to $2.32 a year for each cow. Very significant also is the fact that the cost for range alone was 1.22 cents per pound, or nearly 10% less than for the cows on overgrazed range that gained 114.7 pounds less than those in Lot 2.

This increase in production cost is doubly significant from the fact that it was recorded before any perceptible range deterioration resulted from two seasons of overgrazing, starting with range in practically virgin condition. This 10% difference in cost of gains promises to increase under continued overgrazing.

It will also be noted that the average for Lots 2 and 3 combined, with 34.6 acres per head gave a range cost of 1.40 cents per pound of gain which is very slightly more than the cost of 1.34 cents per pound when only 23.1 acres per head was allowed. Is the added stability and feed insurance represented by the extra 10.5 acres per head worth the slightly increased cost? The results of emergencies during such drought years as 1919, 1931, 1934 and others provide an emphatic affirmative answer. The extra expense of providing 38.8 acres per head, as in Lot 3, seems at this stage of the experiment to be unwarranted. Probably 33 to 36 acres of such range per head will prove to be about the right balance, costs and stability considered.

Data on the first crop of calves for these 60 cows, consisting of 56 live calves born, with 54 left at weaning time in October 1933, are given in Table 1. These same cows had a total of 45 live calves in April and May, 1934. The percentage by lots is, Lot 1, 60%, Lot 2, 95%, Lot 3, 70%, or an average of 82½% for Lots 2 and 3. The 1934 calves from Lots 2 and 3 average 76.0 pounds at birth, as against an average of 66.8 for those from overgrazed range, an advantage of 9.2 pounds for the former. The 3.7 pound birth weight advantage for the 1933 calves spread to 28.1 pounds by October. It remains to be seen what the 9.2 spread of this year's calves will amount to by weaning time.

The relatively undamaged range of Lot 1 after only 2 years of overgrazing, as compared to seriously depleted condition of most overgrazed ranges, is still very outstanding. This, together with the fact that the same care and the same amount of supplemental winter hay was given uniformly to all lots, has excluded from the above results part of the higher costs and the normally greater risk of wintering thin cows on the average overgrazed range. Some preliminary attempt to evaluate this greater cost and hazard, deliberately excluded so far by the plan of this experiment, seems warranted at this point, even though data is not complete.

Thrifty breeding cows normally require not more than 750 pounds of hay per head for wintering during a total 40 to 50 days in the windswept Northern Great Plains Region, provided they are placed on fresh range late in the fall, as the above cows have been. This estimate is double the average feeding period of 22 days and two and one-half times the average of 300 pounds of hay provided as the only supplemental feed to all the above cows alike during the winters of 1932-33 and 1933-34. The first of these winters was nearly normal for severity, but the last one was unusually mild.

With a light allowance of hay and a liberal allowance of relatively cheap range forage, as provided in this experiment, the average cost of hay at $8 per ton, using 750 pounds per head, is $3. Experience has shown that at least 1500 pounds of hay worth $6 at the above price, is needed on the average for wintering cattle in the Miles City region on overgrazed range where winter forage is scanty. This difference of $3 per head for hay is the price paid to avoid an expenditure of 50 cents to $1 per head for 7½ to 10 acres of additional range at prevailing lease prices. Thus, a saving in wintering costs of at least $2 per head may be had by a better balance of range and hay. This practice of substituting expensive hay, or other harvested feed, for cheap range forage, has unnecessarily increased range production costs. Correction of this practice by lighter grazing of the range and using less hay will greatly reduce production costs without unnecessary risks, provided a surplus of stored feed is available for the unusual winter.

Summing up then the extra value of weight gains of $2.32 per head plus a possible $2 saving in wintering costs when no weight gains for mature cows are expected, gives a possible margin of $4.32 per head to gain by conservative grazing over overgrazing the range. Full use of this possible margin may prove necessary in order to get profitable production under prospective low market prices.

Overgrazing then reduces the calf crop, increases the cost of weight gains at market time and increases wintering costs. It also tends toward overproduction and financial unstability during drought or other emergencies. Conservative grazing, on the other hand, largely avoids these difficulties and has the additional merit of preserving range resources.

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No. 67 January, 1935 Missoula, Montana.

The following rating of the character of the 1934 fire season in western Montana and northern Idaho has been prepared for the benefit of timber protective agencies who do not as yet have all the facilities necessary for measuring forest fire danger. As some of the agencies may not be familiar with the method used, the important features have been outlined. The Northern Rocky Mountain Forest and Range Experiment Station plans to issue a similar rating annually hereafter.

L. F. Watts, Director.

The Rating of Forest Fire Danger

by

H. T. Gisborne, Silviculturist.

At the end of each fire season every agency responsible for forest fire control attempts to justify its existence by summarizing its records and showing that in spite of the fire danger that existed, the timber losses, area burned, and expenses were less than they might have been. Sometimes these attempts are entirely successful; other years the Forester at Washington may doubt that the Region did as well as it might have; the head of the National Park Service may call for more information; the Chief of the Indian Service may investigate personally; the State Board of Forestry may be rather skeptical concerning the State Forester's report; and the private timber protective association directors may conclude that they need a change of fire wardens. When this is the case, it is usually for the reason that the higher authorities doubt that the character of the fire season warranted the losses and costs shown by the report.

Every annual report of forest fire control should, therefore, state: first, the character of the fire season; second, the losses and costs; and third, the reporting officer's explanation of the efficiency or lack of efficiency shown. If the character of season is not shown fully and dependably, it may be that the reporting officer prefers not to be too explicit, or it may be that methods of measuring and describing the character of season were not available. Until recently satisfactory methods have not been at the disposal of all agencies.

During the past several years the Northern Rocky Mountain Forest and Range Experiment Station has been studying differences between fire seasons, the factors of fire danger, methods of measuring these factors, and the development of a scale for rating the character of a fire season. The latter has been especially needed because even with quite complete measurements of weather, fuel moisture, visibility, etc., the reporting officer could, according to the factors which he chose to emphasize, produce a danger rating generally suiting his needs. Certain factors of fire danger are recognized as of major importance, however, and always should be included in such a report. Furthermore, uniform rating of fire danger demands that these factors be integrated in the same way by all individuals, otherwise the final classifications of danger are not likely to be comparable, either from year to year or between agencies.

In the Northern Rocky Mountain scheme the factors selected for daily measurement include: (1) season of the year, (2) activity of man and lightning as causative agencies, (3) visibility distance or ease of detection, (4) afternoon fuel moisture or inflammability, (5) afternoon wind, and (6) minimum, or 5 p.m. relative humidity. These are integrated by use of a device called a Fire Danger Meter so that danger is expressed in seven classes. When all factors are most favorable for fire control, the meter integrates them and shows Class 1, or lowest danger. When all factors are most unfavorable the meter will show Class 7, or highest possible danger. Field tests on each of the National Forests in this Region during the 1933 and 1934 fire seasons have shown that when conditions were recognized as uniform over several Forests the meter ratings were similar, and that when the meter ratings differed there were real differences in fire danger.

By use of these daily measurements and ratings it is now possible to describe fire danger on a numerical scale just as the thermometric scale is used to describe heat. The person without a thermometer can only report to another by use of such general terms as hot, pretty hot, quite hot, "darned" hot, etc., which are neither specific, accurate, nor comparable, but a report of a temperature of 96° F. is specific, as accurate as the thermometer, fully comparable with previous measurements with that same instrument, and is understood by every one. After the new scale for fire danger has been used for a season, the user learns the exact significance of each class of danger, understands what others mean when they use that scale, and is able to compare one day with another, or one year with another.

It is also possible now to express fire danger as a percentage of the worst probable danger. This is desirable because expressions of percentage are readily visualized by everyone including the higher authorities who may not have the time to familiarize themselves either with the technicalities of measuring fire danger or with the significance of classes of danger.

Using this method of description, the peak months of July and August, 1934, rated as follows on the fire Forests of western Montana and northern Idaho: Bitterroot 80%, Cabinet 88%, Clearwater 89%, Coeur d'Alene 82½%, Flathead-Blackfeet 92½%, Kaniksu-Pend Oreille 80%, Kootenai 84%, Lolo 89%, Nezperce 90%, old Selway 83½%, and St. Joe 81½%. By weighing these ratings according to the area represented, it is then possible to state that the average fire danger on these 16,195,000 acres of forest land was 86% of the worst probable. By comparison with similar measurements for the same area during July and August, 1933, it is found that forest fire danger was 12% greater in 1934 than in 1933.

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68

APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
AND
COOPERATING AGENCIES *

No. 68 May, 1935 Missoula, Montana.

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ROCKY MOUNTAIN STATION

A Comparison of Long-Log and Short-Log Scale.

By C. W. Bloom, Junior Forester

To determine the difference, if any, between the board-foot volume of long logs as scaled in the woods and that of the same logs as scaled after they are cut in the mill into short lengths, a comparison was made on the basis of data obtained in a logging output study on Bobtail Creek, Kootenai National Forest, Montana. Of the total volume represented by these data, 3 percent was Douglas fir and 97 percent was mature ponderosa pine.

The short log is the standard unit of scaling practice in the Inland Empire, whether volume is measured in tree lengths or in long-log lengths. Short-log lengths range from 10 to 20 feet, varying by 2 feet or multiples thereof. The most common short-log length is 16 feet.

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*Forest Service, Region One; University of Montana; Montana State College of Agriculture; University of Idaho; Office of Blister Rust Control; Weather Bureau; Bureau of Entomology, and private agencies.

The long logs from which the study data were derived ranged in length from 24 to 42 feet. At the railroad landing, two scalers made a record of the number of each log and of its gross and net scale. At the sawmill, the lengths and volumes of the short logs obtained from each long log were tallied separately. The length distribution of the short logs was as follows:

Feet	Percent
12	32.4
14	25.8
16	37.3
18	2.7
20	1.8

The short logs averaged 6.8 per 1000 board feet, net, log scale.

The volume differences between long logs scaled as such and the same logs scaled in the form of short logs are indicated by the accompanying table. The volume of the long logs as scaled on the sawmill deck substantially exceeded the volume of the same logs as scaled at the railroad landing. The average excess was 9.3 percent gross scale and 6.6 percent net scale.

If the short-log scale is accepted as standard, this study indicates that long-log scaling tends to show volumes somewhat too low.

VOLUME OF LOGS AS SCALED IN LONG LENGTHS AND VOLUME OF THE SAME LOGS AS SCALED IN SHORT LENGTHS

Top Diameter of Logs, Inside Bark	Long Logs	Average Volume Per Long Log, as Scaled in Long Lengths at Railroad Landing (Scribner Decimal C Rule)		Total Short Lengths Cut From Long Logs	Average Volume Per Long Log, as Scaled on Sawmill Deck After Being Cut Into Short Lengths (Scribner Decimal C Rule)		Average Difference in Volume When Long Logs were Scaled as Short Lengths			
		Gross	Net		Gross	Net	Gross		Net	
Inches	Number	Bd. Ft.	Bd. Ft.	Number	Bd. Ft.	Bd. Ft.	Plus %	Minus %	Plus %	Minus %
7	6	53	53	13	73	73	38		38	
8	8	71	71	17	115	110	62		55	
9	18	92	92	41	116	114	26		24	
10	17	122	121	38	149	140	22		16	
11	9	141	135	19	151	132	7			2
12	10	180	175	21	216	197	20		13	
13	12	218	208	25	249	242	14		16	
14	9	238	227	19	271	261	14		15	
15	17	303	303	37	346	341	14		13	
16	5	322	304	10	330	278	2			9
17	14	405	403	30	426	425	5		5	
18	6	413	413	11	411	411		1		1
19	7	490	470	14	540	485	10		3	
20	4	572	572	8	620	620	8		8	
21	2	755	755	5	805	805	7		7	
22	5	642	642	10	662	645	3			
23	7	750	740	14	754	708				4
24	1	980	860	2	800	690		18		20
25	2	900	900	4	900	875				3
26	3	960	960	6	1136	1046	18		9	
27	1	1130	1130	2	1080	1080		4		4
28	1	1190	1190	2	1240	1240	4		4	
29										
30	2	1340	1315	4	1375	1360	3		3	
31	1	1450	1450	2	1440	1440		1		1
Total	167			354						
Average		324	320		354	341	9.3		6.6	

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69

APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
AND
COOPERATING AGENCIES*

No. 69 June, 1935 Missoula, Montana

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REGRASSING MONTANA DRY FARMS

By Leon C. Hurtt
Senior Range Examiner.

Several million acres of splendid native range in eastern Montana were unwisely put to the plow during the dry farming boom before the 1919 and subsequent drought years halted the destruction and started an exodus of dry farmers. Regrassing of such land that now produces little but weeds after five to ten, or even twenty, years since the last crop trial is a major rehabilitation job. Grass will not only yield taxes and produce wealth, but will help to keep top soil in place rather than to form dust clouds and silt up irrigation projects.

Reseeding Plans and Methods

With an allotment of Federal emergency funds made to the Northern Rocky Mountain Forest and Range Experiment Station in September, 1933, a range reseeding program combining research and demonstration was set up with the following questions in mind:

1. Can reseeding methods be developed that will be cheap enough for use on low-valued range land?
2. What native or introduced range plants are most promising under this limitation?
3. Which is preferable, fall or spring seeding?
4. What is the relative grazing value of each species for different classes of livestock?

Certain detailed phases of the reseeding work are being conducted in a grass nursery at Missoula, on several National Forests, and at the U. S. Range Livestock Experiment Station (old Fort Keogh) near Miles City, where controlled experiments and careful records can be obtained. However, the need for demonstrations under practical ranch operating conditions was recognized. More than 40 selected ranchers have entered into five-year cooperative agreements and have done most or all of the actual reseeding work on five to forty acres of their own land. Supervision and seed are furnished by the Forest Service. So far, 22 central and southern Montana counties from Granite on the west to Custer on the east are represented by one to four cooperators, including some 4H Club boys. Funds allotted for this work are now exhausted, which has necessitated rejection of numerous requests for cooperation.

Previous work by other experiment stations has demonstrated that some of the forage species being investigated can be grown in Montana under the best tillage practice. Efforts are therefore directed primarily toward developing methods that will hasten nature's slow progress at regrassing range land at a cost that will pay dividends. For the sake of comparisons, soil on a portion of certain demonstration fields was prepared by disking or plowing and the remainder of the field was drilled without soil preparation. With minor exceptions, however, an ordinary grain drill has been used to reseed, without soil preparation, fields that have been uncultivated for two, three or more years. Burning of dead weeds that seriously interfered with the drill was necessary on a few fields. This absence of soil preparation, in addition to being economical, has the further advantage of preserving most of the valuable native forage plants that may have become established since the soil was last cropped. Varying numbers of the drill feeds have been blocked to give rows 12 to 30 inches apart, and in a few cases unseeded strips 20 and 30 feet wide with one drill width seeded between have been tried. Transplanting small blocks of buffalo grass sod with various spacing has also been tried.

Results for the First 18 Months

Approximately 1,100 acres have been seeded since October, 1933. About 425 acres were seeded in the fall of 1934 and 450 acres in April and May, 1935. Recent incomplete reports and inspections indicate a high degree of success for this 875 acres, but final results for work done during the past eight months will not be available before October.

The remaining 225 acres, seeded in the fall of 1933 or in the spring of 1934, suffered one of the worst droughts ever recorded for eastern Montana. Precipitation at Miles City during 1934 amounted to only 5.51 inches, or 40% of normal, while at Ingomar in Rosebud County less than five inches occurred. A check-up in the fall of 1934 on this 225 acres showed a reasonable degree of success under range reseeding standards on at least 70 acres, or more than 32% of the total. Failure in some cases was clearly due to late spring seeding or to covering seed too deep. A recent partial check-up showed a fair degree of success on some of the remaining 155 acres that were classed as complete failures last fall. Some seed that laid dormant in the ground for six to twelve months germinated and came up after the rains of last October, and now promise fair stands. Furthermore, some of the grass that came up in April, 1934, appeared to be quite dead during the drought through July and August, but revived after fall rains and now promises a fair stand. Present indications point to final success on at least 40 percent of the acreage planted late in 1933 or in the spring of 1934.

Promising Species

Crested wheat grass, a perennial introduced from Siberia, appears to be the most promising for range reseeding under drought conditions that prevailed through 1934. It starts growth early in the spring, revives quickly after fall rains, is a prolific seed producer and seems able to choke out Russian thistles, cheat, or annual brome grass. This species has been used on about 75 percent of the total acreage, but 19 other species were used to some extent.

Slender wheat grass, a native of Montana, smooth or Hungarian brome, meadow fescue, Canada blue grass, tall oat grass, and Harbin lespedeza also give considerable promise. Lespedeza is a legume, introduced in recent years from the dry, cold portion of Manchuria, but as yet is scarecely known in Montana. It is an annual, but it has proved its ability to reseed itself in our Missoula grass nursery.

The price of crested wheat grass seed has gone up during the past two years from about 20 to 75 cents per pound. The latter price is a serious obstacle to its extensive use. Three to four pounds of crested wheat grass. or eight to ten pounds of the other grass seed per acre, appear to be adequate for range reseeding in the semi-arid plains. With the former at 20 cents per pound and others at ten cents or less per pound, reseeding may still be done under the foregoing methods at a cash outlay of about $1 per acre, plus relatively low labor costs. Drilling labor with owned equipment should not cost to exceed an additional 30 to 50 cents per acre.

Twenty yearling steers were started recently on an experiment to determine the range value of crested wheat grass as compared to native pastures, but results will not be available from this test for some time.

A preliminary conclusion from the work so far is that a very great acreage of plowed and abandoned Montana range land can be reseeded at a cost that will be justified by increased carrying capacity and by reduced wind and water erosion.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
AND
COOPERATING AGENCIES*

No. 70 July 1935 Missoula, Montana.

PROGRESS REPORT ON THE FOREST RESOURCE SURVEY

By G. M. DeJarnette, Associate Forester

Purpose

The purpose of the survey is to obtain and compile, in such manner that it will be readily available for use, all of the pertinent data on the timber resources of Region One.

The final report will include:

1. An inventory of all timber resources.
2. A classification of all timberland as to productivity and accessibility.
3. An estimate of the annual drain on timber resources by cutting, fire, insects, and other losses.
4. An estimate of the commodity requirements for timber from the Region.
5. The annual increment of wood and forest products in the Region.
6. Other pertinent facts regarding the growth, movement and stability of the timber industry.

History

The National Forest Survey was brought into being by the McSweeney-McNary Forest Research Act of 1928.

Work was started in this Region late in 1931, with M. I. Bradner, Chief of the Office of Forest Products, Northern Rocky Mountain Forest and Range Experiment Station, in charge, and G. M. DeJarnette, assistant.

Conferences with the Regional Office, other public agencies, and representatives of the timber industry resulted in the laying of preliminary plans and the formulation of general policies. The "compilation method" was decided to be the most desirable one for Region One. Under this method, all available information from every source is collected, sorted, checked, and corrected to bring it to a common standard of accuracy. The areas for which no information are obtainable are covered by field mapping and cruising. Cruise information is available on nearly all of the mature merchantable timber of the Region. Very gratifying cooperation by private timber owners and other public agencies has made this information available to the survey. The field work, therefore, is largely confined to the areas of cutover and burned-over lands, and the poorer grades of less accessible mature timber, all of which can be covered with a minimum of field expense.

Collection of cruise data was started in January 1932. Field work on a small scale was initiated in May 1932. During that season, three men worked on the mapping of blank areas and two men on the checking of collected information. Since that time the work has progressed on an increasing scale, both in the field and office. In 1933, a total of six field mappers was employed for part of the season. During the summer of 1934, an average of 30 men mapped in the field and about the same number have been employed on office compilation since the end of the 1934 field season.

Progress

The first unit set up to be worked in the Region was that portion of the "Inland Empire" included in Montana, west of the Continental Divide; Idaho, north of the Salmon River, and Washington, in Spokane, Stevens and Pend Oreille Counties. Within this unit there are approximately 26,000,000 acres of land to be covered by the survey.

On the accompanying tabulation, under the heading "Percentage of Job Completed," are listed the four major divisions of the work of the inventory phase of the survey. "Collection" represents the work of assembling and sorting the cruise information available from the various sources; "Field Mapping" is the work of covering areas for which no satisfactory information is obtainable, and supplying missing data, such as age and site, on areas of mature timber where volume data alone have been obtained; "Adjustment Cruising" consists of checking the collected cruise estimates in the field and adjusting them to a common standard; "Office Compilation" is the job of welding the mass of information obtained by collection and field work into a complete summary of volume and type area data for the entire acreage of Forest land within the unit; the "Report" will be a brief economic description of the history and prospects of the timber industry within the counties involved.

The percentages as shown give a fair picture of progress, but they do not tell the whole story. Included in the time and money which have been spent on the project thus far is a large amount for preliminary plans, training of personnel, development of methods, and the purchase of cars and field equipment sufficient for an organization of thirty men. The project is now in such shape that it can realize on this investment, especially if the present organization can be held together. Neither do the progress percentages reveal the fact that the most difficult part of the unit has been completed, with respect to the field mapping and compilation. The area covered includes the most broken type conditions as well as some of the most valuable timberland in the Region. The latter class of land naturally deserves more careful consideration than the rough back-country areas included in the National Forests. On a large part of the back country, there is already sufficiently accurate coverage and very little, if any, adjustment to Forest survey standards is needed.

On the accompanying map, the total area to be covered is outlined, and the area on which field work has been completed is shown in colors according to the year worked.

Cover maps for all of the area which has been covered to date are in final form. Photostat negatives have been made of each township. From these, either 1-inch or 2-inch-to-the-mile reproductions may be made. The plain positive prints show timber and other cover data by lines and type symbols. Colored maps show the above in color, in addition to the symbols. These maps are available at cost, for distribution to those having use for them in township units, in either size, upon order. Considerable use is being made of the 2-inch type maps by the A.A.A., and other agencies. The information, while necessarily of an extensive nature, is filling a need for a cover map of a degree of accuracy which will permit its use for extensive planning or land transactions involving large tracts of low-value land. It is not designed for use where detailed information is desired on small tracts or where high values are involved. Work is also going forward on 1-inch-to-the-mile black-line prints, which will be published in units of about 40 townships each and will show the cover types in more generalized form. These maps will give a good picture of the general cover types of the Region.

It is expected that some preliminary statistical data can soon be released. Compilation work has progressed to the point of complete type acreage figures for two counties. Total volume figures are complete in one county - Benewah, in Idaho. These will be released by ownership classes, that is: "Large Private," "Small Private," "State," "County," "Federal," etc. No releases are to be made showing individual ownerships.

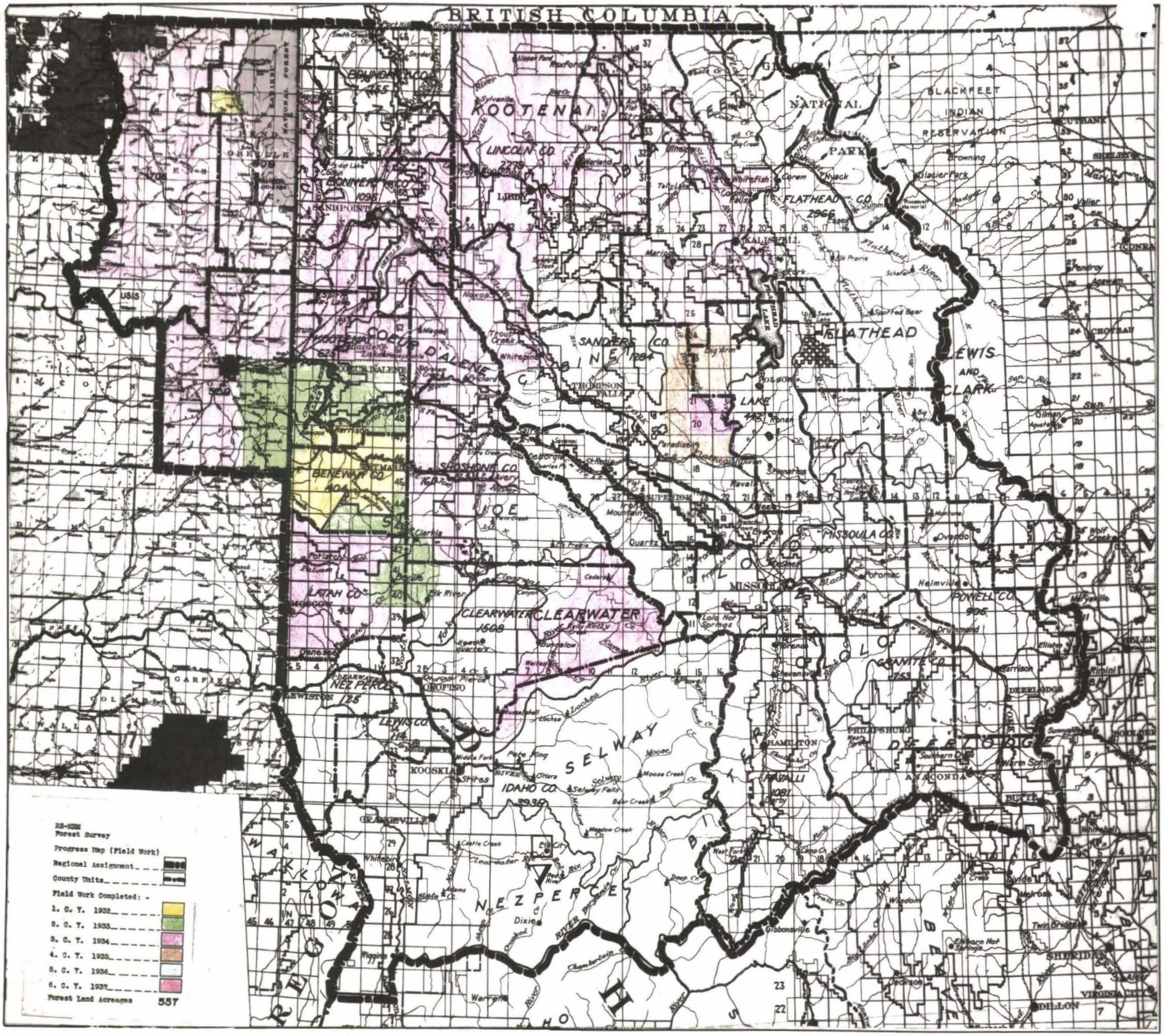
Progress on the survey has been impeded, except in the season of 1934, by undependable and inadequate financing. The present situation is such that it is impossible to make worthy plans; in fact, no field work has been done as yet this season and, unless some way is found to finance the project by July 1, an almost complete cessation of activities will be necessitated.

NRM
Forest Survey
Inland Empire

PROGRESS REPORT

As of: 7/1/35

UNIT	Est. Area Forest Land in M. Acres Inside N. Forests	Outside N. Forests	Total	Percentage of Job Completed Collection	Field Mapping	Adj. Cruising	Office Compilation	Report
IDAHO								
Benewah	16	388	404	100%	100%	100%	90%	
Bonner	446	649	1,095	100%	85%		60%	
Boundary	417	338	755	95%	10%			
Clearwater	641	867	1,508	100%	35%		25%	
Idaho	3,490	445	3,935	90%	1%			
Kootenai	202	423	625	100%	100%		90%	
Latah	31	400	431	100%	97%		90%	
Lewis		114	114	100%				
Nezperce		125	125	100%				
Shoshone	977	634	1,611	100%	59%	100%	40%	
TOTAL, IDAHO	6,220	4,383	10,603	97%	37%	18%	29%	
MONTANA								
Deerlodge	60	15	75	90%				
Flathead	1,843	1,123	2,966	100%	30%		15%	
Granite	620	133	753	75%				
Lake		442	442	90%	25%			
Lewis & Clark	140	80	220	90%				
Lincoln	1,655	624	2,279	100%	85%		50%	
Mineral	576	164	740	75%				
Missoula	567	833	1,400	85%				
Powell	515	390	905	95%				
Ravalli	928	153	1,081	80%				
Sanders	822	462	1,284	80%	25%		15%	
TOTAL, MONTANA	7,726	4,419	12,145	95%	26%		15%	
WASHINGTON								
Pend Oreille	267	642	909	100%	100%		90%	
Spokane		559	559	100%	100%	100%	95%	
Stevens	64	1,642	1,706	100%	100%		90%	
TOTAL, WASHINGTON	331	2,843	3,174	100%	100%	18%	91%	
TOTAL, INLAND EMPIRE	14,277	11,645	25,922	95%	40%	10%	29%	


BRITISH COLUMBIA
KOOTENAI
LINCOLN CO.
2279
BOUNDARY CO.
BONNER CO.
1095
SANDPOINT
FLATHEAD CO.
2966
GLACIER NATIONAL PARK
BLACKFEET INDIAN RESERVATION
KALISPELL
SANDERS CO.
1284
CABINET
LAKE
442
FLATHEAD
LEWIS AND CLARK
KOOTENAI CO.
625
COEUR D'ALENE
BENEWAH CO.
404
SHOSHONE CO.
1610
ST. JOE
LATAH CO.
431
MOSCOW
CLEARWATER CO.
1608
CLEARWATER
NEZ PERCE CO.
125
LEWISTON
LEWIS CO.
114
OROFINO
KOOSKIA
GRANGEVILLE
IDAHO CO.
3938
SELWAY
NEZPERCE
MISSOULA CO.
1700
MISSOULA
LOLO
POWELL CO.
996
GRANITE CO.
753
RAVALLI
1081
HAMILTON
BITTERROOT
DEERLODGE
ANACONDA
BUTTE
DILLON
BEAVERHEAD
WALLOWA
OREGON
WASHINGTON
GARFIELD
COLUMBIA
WALLA
SPOKANE
PEND OREILLE
KANIKSU NATIONAL FOREST

RS-NRM
Forest Survey

Progress Map (Field Work)

Regional Assignment
County Units
Field Work Completed: -
1. C. Y. 1932
2. C. Y. 1933
3. C. Y. 1934
4. C. Y. 1935
5. C. Y. 1936
6. C. Y. 1937
Forest Land Acreages 557

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71

APPLIED FORESTRY NOTES

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NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
and
COOPERATING AGENCIES

No. 71 July, 1935 Missoula, Montana

CATTLE PRODUCTION COSTS ARE INCREASED BY OVERGRAZING

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Leon C. Hurtt, Senior Range Examiner

That overgrazing significantly increases the cost of producing range cattle in comparison with lighter range use is shown by preliminary results from a grazing experiment at the U. S. Range Livestock Experiment Station near Miles City, Montana. This experiment was started in 1932 by the Forest Service in cooperation with the Bureau of Animal Industry and the State of Montana to measure effects on the cattle, as well as on the vegetation of grazing yearlong ranges at three contrasting intensities of use. The area is quite typical of short grass ranges of eastern Montana, but previous to the experiment had been grazed more lightly and as a result, was in better condition than average. Both summer and winter pastures are included, the former are grazed from about May 15 to November 15, and winter pastures for the remaining six months of the year. One set of these pastures is overgrazed by about 25 percent, one set is moderately grazed to leave a substantial amount of the less desirable forage, while the third set is lightly grazed so that about 25 percent of even the choice forage growth is left at the end of the grazing period, all based on a normal season.

Results of Varying Degrees of Grazing on the Forage

Records of a detailed nature from more than 75 quadrats, clipped and other sample plots, showed a reduction of 28 percent in density of vegetation in 1934 as compared to 1933. This reduction during these first two years was not significantly greater for overgrazed than for moderately grazed pastures. The full effects of the 1934 drought were not reflected by records taken that year mainly during June and July. A large additional reduction, especially in gramma and buffalo density, is appearing in records now being taken, but these 1935 data have not yet been summarized.

Volume of forage produced in 1934 was reduced very much more drastically than was density. Based on clipped plots and other indicators, this range produced only approximately one-fourth the normal volume. The dry fall of 1933 was followed in 1934 by the worst drought of record when the precipitation at Miles City amounted to only 5.51 inches, just 40 percent of the 13.79 inches normal. This drought and feed shortage forced 60 to 80 percent of the livestock out of southeastern Montana at ruinous prices.

It is of interest to record for comparison the reductions caused by the 1934 drought in Bureau of Animal Industry range livestock at the Experiment Station. Twenty-five yearling heifers, originally scheduled for replacement of older cows, were sold; also, 173 yearling and two-year-old steers, including some spayed heifers, all of which would have been kept one or two more seasons except for the drought. The usual number of breeding cows and practically all the 1934 steer and heifer calves were also kept, but the Station sheep were reduced by approximately 25 percent and light range horses by ten percent. Sold animals brought prices substantially higher than those paid under the drought relief program. The total reduction on experiment station ranges was less than 20 percent. The remaining 80 percent of normal numbers were wintered with very small losses with a small amount of cottonseed cake during calving, plus a reserve of hay and range forage built up through a policy of conservative stocking during more normal years. This contrasts sharply with much heavier forced reductions on surrounding overgrazed ranges.

Results of Overgrazing on Sixty Experimental Cows

The feed cost and weight records for experimental cows and their calves have responded most strikingly to the three intensities of grazing and to the drought. When this project started, 60 two-year-old, pure-bred Hereford cows were carefully selected for the experiment. Twenty of these cows were placed on pastures to be overgrazed Lot 1; 20 on pastures to be moderately grazed Lot 2; and 20 on pastures to be lightly grazed Lot 3. At the beginning of the experiment, there was less than eight pounds variation in the average weight of cows in these three lots. During most of the intervening time, the cows on overgrazed range have been 40 or more pounds lighter than the average for the other two lots, with the difference amounting to 90 pounds at the end of the relatively normal 1933 summer season.

Until July 20, 1934, each of the three lots of cows had exactly the same care, watered at the same wells, and had the same supplemental winter feed so that the difference in grazing intensity was the only variable. Due to the drought, the forage at that time was practically exhausted on the overgrazed pastures and supplemental feeding of hay was necessary to prevent starvation losses of cows in Lot 1. As the drought continued and the hope for fall rains faded, hay feeding was required on September 5 for the Lot 2 cows on moderately grazed range, and on September 14 for those on Lot 3 on lightly grazed ranges. All cows were moved to feed lots in November, but were returned to their pastures for calving on April 2, 1935.

With the exception of this November to April period of 4-1/2 months during the winter of 1934-35, the cows were never off their range pastures from July, 1932, to the present.

During the winters of 1932-33 and 1933-34, supplemental hay amounting uniformly to an average of 430 pounds was fed during 28 days the first winter and 170 pounds during 18 days of the second winter, or an average of 600 pounds for two winters, inclusive. Otherwise, the cows have subsisted entirely on range forage, water, salt and bone meal up until last July when the drought necessitated summer feeding, as already explained.

A Six-Weeks' Range Breeding Practice Followed

Uniform bulls from the same sire have been used in the range pastures at the rate of one bull for ten cows for six weeks each season, beginning about July 4. Yearling bulls have now been satisfactorily used during two seasons, but two-year-olds were used in 1933. The cows are now five years old and their third calf crop amounted to 60 percent for cows on overgrazed pastures and 75 percent for each of the other two lots on moderately and lightly used pastures. Data for this 1935 calf crop are not included in the following tabulation.

A summary of data for two years on calf crop and weights, supplemental feed used and certain cost figures for these 60 cows grazed, as already described, follows.

The following points are noteworthy from a detailed comparison by lots of calf weights during the two seasons: (1) the lighter average birth and weaning weight of calves on overgrazed range; (2) the nearly parallel trend in weight for calves on moderately and lightly grazed pastures; (3) the increasing divergence in weight, as the season advanced, of the calves from overgrazed as compared to those from moderately and lightly grazed ranges; (4) the calf weights during the

COMPARATIVE CALF CROPS AND CALF WEIGHTS FOR THREE INTENSITIES OF GRAZING DURING 1933 AND 1934

	Twenty (20) Cows in Lot 1 Overgrazed Range	Twenty (20) Cows in Lot 2 Moderately Grazed Range	Twenty (20) Cows in Lot 3 Lightly Grazed Range
No. live calves born, two years	30	39	32
Percent calf crop, ave. two years	75%	97½%	80%
Weight of calves at birth, average two years	68.4#	74.9#	71.5#
Weight of calves at weaning, average two years	(30)° 263.4#	(37)° 300.7#	(31)° 309.2#
Weaning weight, prorated to 20 cows, average two years	197.6#	278.1#	239.6#

°Number of calves at weaning time for two years in parenthesis.

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COMPARATIVE AMOUNT AND COST° OF RANGE AND HAY USED PER POUND OF CALF WEIGHT PRODUCED DURING TWO YEARS.

	Lot 1 - Overgrazed Range	Lot 2 - Moderately Grazed Range	Lot 3 - Lightly Grazed Range
Average range acres per cow	23.1	30.5	38.8
Pounds hay fed winter 1932-33	430	430	430
Pounds hay fed winter 1933-34	170	170	170
Average hay per cow, two winters	300	300	300
Pounds hay summer 1933	None	None	None
Pounds hay summer 1934 (drought)	2027	1267	848
Cost of hay and range per pound of calf weight produced 1933	1.52¢	1.57¢	2.32¢
Cost of hay and range per pound of calf weight produced 1934	8.5¢	3.5¢	3.9¢
Weighted average cost per pound, two-year	3.84¢	2.44¢	2.83¢

° An $8 instead of the prevailing drought price of $20 per ton for baled hay and of 10¢ rental per acre for range is used above. The actual period is from December 1, 1932, to October 18, 1934, six weeks short of two full years because of the drought.

1934 drought from moderately and lightly used ranges were heavier up to about September 1, than at a corresponding date in 1933, while those from overgrazed range averaged much lighter even with the benefit of supplemental hay beginning in July, 1934. There was a feed reserve from the previous year on moderately and lightly grazed ranges, but not on the overgrazed ranges.

Summary and Preliminary Conclusions

Hay and range forage used are the variable factors and are included in the above cost data, but other costs that are uniform for the three lots are not included.

The average calf crop for two years was thus 75 percent, 97-1/2 percent, and 80 percent, respectively, for overgrazed, moderately grazed, and lightly grazed pastures. Including the 1935 record, the three-year calf crop averages become 70 percent, 90 percent, and 78 percent, respectively. The average calf weaning weight prorated to the total number of cows grazed was 197.6, 278.1, and 239.6 from overgrazed, moderately grazed, and lightly grazed pastures, respectively.

With hay figured at $8 per ton and range forage at a ten-cent per acre annual rental, the per pound cost of weaning calf weight produced on overgrazed range pastures was 1.4 cents or 57 percent higher than on moderately, and 1.0 cents or 37 percent higher than on lightly used range. Taking the drought year only, the cost per pound of calf production was 8.5 cents, 3.5 cents and 3.9 cents, respectively. Thus, the cost on overgrazed range was more than double the per pound cost on either moderately or lightly used ranges during the 1934 drought year. ~~Bear~~ in mind that this penalty in increased cost of production was effective before the range vegetation was materially damaged by overgrazing. The spread may be expected to increase as the overgrazed pastures decline under continued overgrazing. The need for conservative grazing to build up a reserve of range forage for use to keep costs down during drought years is thus strikingly emphasized.

Overgrazing causes increased depreciation of breeding cows, reduces the calf crop, increases the expense for supplemental feed, and thus greatly increases the cost of gains. An ample range allowance is cheaper than hay. Overgrazing also tends toward overproduction and to serious demoralization of finances and of established breeding herds during droughts and other emergencies. Conservative grazing, on the other hand, not only minimizes or avoids these difficulties, but preserves the range resources.

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NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION
AND
COOPERATING AGENCIES*

No. 72 July, 1935 Missoula, Montana.

MATCH PLANK AND COMMERCIAL LUMBER FROM WESTERN WHITE PINE LOGS

By I. V. Anderson, Forester.

Out of the 356 million feet of western (Idaho) white pine produced in 1934 in the Inland Empire a total of 101 million feet was match plank. This constituted 28 percent of the total cut and was approximately the same as the 1933 match plank production when 98 million feet were produced. If the production for these two years is indicative of the normal requirements, the importance of perpetuating this source of raw material for the match industry is apparent.

The question is often asked: What commercial lumber grades are contained in the average run of match plank? The attached tabulation answers this question for a small run of match plank produced from logs cut on the Little North Fork of the Coeur d'Alene River in Idaho. The data are not considered as indicative of regional averages but may be used as a guide.

Caption three of the table shows that 140,122 feet of match plank contained six percent select and 94 percent common lumber. Of the latter grades, 80 percent was two and three common. In arriving at these commercial grades, the inspector ascertained the green grade of both sides of 8/4 and 10/4 plank which were sawed "full" to permit resawing 8/4 plank to two 4/4 boards and 10/4 plank to one 4/4 and one 6/4 board.

Plank of 8/4 and 10/4 thickness rejected (match plank rejects) for sale or use as match plank are usually resawed and sold on the commercial lumber market. Caption four shows that this class of plank contained three percent selects and 97 percent common. Of the latter grades, 64 percent was three and four common.

Match plank rejects and incidental commercial lumber resulting when logs are cut for match plank as a major product forms the basis for percentages shown under caption five. Therefore, these figures may be used as an indication of the commercial lumber grades obtained by the operator who saws primarily for match plank.

It is apparent from this study that clear lumber is not necessary for match production, as the match plank in this study contained only six percent select of which two-thirds was D select.

MATCH PLANK AND COMMERCIAL LUMBER FROM WESTERN WHITE PINE [1]

Lumber Grades [2]													
Match Plank		Select					Common						
10/4	8/4	Supreme (B &Btr.)	Choice (C)	Quality (D)	Shorts	All	Colonial (No. 1)	Sterling (No. 2)	Standard (No. 3)	Utility (No. 4)	Industrial (No. 5)	Shorts	All
%	%	%	%	%	%	%	%	%	%	%	%	%	%
1. Match plank and grades of commercial lumber contained in 130,485 feet of logs, net scale.													
23.82	56.45	.030	1.098	1.941	-	3.069	.266	5.125	6.322	4.056	.892	-	16.661
2. Commercial lumber by grades contained in 104,490 feet of logs.													
-	-	.101	2.958	4.945	.043	8.047	4.684	42.113	33.287	10.490	1.375	.004	91.953
3. Commercial lumber by grades contained in 140,122 feet of match plank.													
-	-	.071	1.858	4.060	-	5.989	5.759	47.879	32.461	7.341	.570	.001	94.011
4. Commercial lumber by grades contained in 8,679 feet of match plank rejects.													
-	-	-	.369	2.212	-	2.581	.737	31.225	43.035	20.509	1.913	-	97.419
5. Commercial lumber by grades contained in 8,679 feet of match plank and 22,864 feet of incidental commercial lumber that resulted when logs were cut for match plank as a major product.													
-	-	.152	5.570	9.825	-	15.547	1.414	25.942	32.026	20.550	4.521	-	84.453

[1] Trade name Idaho white pine.
[2] Based on green chain tally.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 73 November 1935 Missoula, Montana

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THE CHARACTER OF THE 1935 FIRE SEASON IN REGION ONE

By

H. T. Gisborne, Silviculturist

In the January 1935 issue of Applied Forestry Notes, Director Watts inaugurated the policy of making available to other forest protective agencies the rating of each fire season on the basis of the detailed measurements made by the Forest Service in Region One. The reasons for such ratings and the method of compilation were described in the issue of Applied Forestry Notes mentioned above.

The following description of the 1935 fire season is based upon more complete and more accurate data than have been available heretofore. The outstanding conclusion from these data is that there were numerous opportunities in 1935 for the development of disastrous conflagrations. That very few fires became large can be attributed only to the excellent protection supplied by all of the forest protective organizations, private, State, and Federal, in the Northern Rocky Mountain region.

The character of the 1935 fire season in Montana and northern Idaho was different from all others. It was a little later than usual in opening, and from four to six weeks later in closing. It also brought greater differences in danger, in different localities within the Region, than have been experienced since measurements of the factors of fire danger were begun.

July and August, which always include the peak of danger, rated this year as bringing 76% of worst probable danger on the ten fire Forests of Region One. This is just 10% less than occurred in 1934, and 2% more than in 1933. There was considerable variation between Forests, however, in 1935. This is indicated by the following rating of the separate Forests showing the percentage of worst probable danger: Nezperce, 85%; Bitterroot, Lolo, and St. Joe, 80%; Clearwater and Flathead, 76%; Cabinet and Coeur d'Alene, 75%; Kootenai, 73%; and Kaniksu, 65%.

Similar ratings are not available for the eastern Montana Forests, but a Weather Bureau map of precipitation for the entire State shows that the rainfall deficiency which contributed to high danger on the Nezperce and Bitterroot extended easterly and northeasterly across the State. This drought, although it has not received so much publicity, rivals that of the preceding year. The few largest fires that occurred on the National Forests in this Region were on the Helena and Absaroka Forests within the dry belt shown by this map.

Additional Weather Bureau records for Helena show the occurrence of 13 days in July, August, and September that brought critical fire danger due to abnormally low humidity and high wind. On each of these 13 days the humidity dropped below 20% AND the wind reached a velocity of 10 m.p.h., or more. On eight of these days, the humidity was less than 15%. On July 27, with a temperature of 98½° and a wind velocity of 18 m.p.h., the humidity reached the extremely low point of 4%. This is the lowest relative humidity ever recorded in 55 years of measurement at the Helena Station. This combination of temperature, humidity, and wind constitutes an extremely critical forest fire day in any Region.

Considering all factors for the entire season and for the entire Region, 1935 rates as high average in the character of conditions with which the fire control organization had to contend. It was definitely not a critical season, neither was it easy or below average. Proof is found in the records of the daily measurements of wind (190 stations), humidity (90 stations), visibility (80 stations), and fuel moisture (65 stations) made on the ten fire Forests.

The occurrence of occasional days of critical danger on certain ranger districts, which was one very important characteristic of the 1935 fire season is not described sufficiently by the ratings of individual Forests given above. On August 10 the following stations reported Class Seven danger (this means such a combination of conditions as will cause fires to spread at rates of 1,500 to 2,000 acres per hour _if_ fires are existing uncontrolled): All ranger districts except one on the Nezperce Forest, Moose Creek on the Bitterroot; Missoula, Lolo, and Seeley Lake Districts on the Lolo; Plains District on the Cabinet; Upper Swan District on the Flathead; and the Bungalow District on the Clearwater. In most cases, the conditions that day included afternoon winds averaging from 15 to over 25 miles per hour, visibility restricted to four miles or less, relative humidities as low as 10%, and fuel moistures as low as 5% at several stations, and down to 4% at Castle Creek on the Nezperce. These are exactly the conditions that prevailed on August 3, 1931, when the Freeman Lake fire burned over 20,000 acres in 12 hours.

Other Class Seven days reported during the past season include July 27 on both the Lolo and Missoula Districts, July 30 on the Bonita District, and August 21 on the Seeley Lake District of the Lolo Forest. The Upper Swan District of the Flathead, on August 9, also rated as Class Seven when the afternoon wind averaged 13 miles per hour, the relative humidity was down to 13%, and the fuel moisture down to 4%.

To offset these extremely dangerous conditions, which had to be met even though they were temporary and localized, the past fire season was relieved by good rains on most of the western Forests during the first ten days of July, during the middle ten days of August, on August 31, and on September 14 and 15. These breaks are extremely helpful if large fires are in progress, but there were no such fires on the western Forests this year.

Another helpful feature was the general absence of lightning storms from July 26 to August 31. The season as a whole rates as below average in the number of days occurence of lightning. The first ten days of September, however, brought far more than the usual number of storm days.

One feature of lightning danger during 1935 deserves special attention. This was the peak load of 433 lightning fires produced by the storms of July 22 to 26, on sixteen of the eighteen Forests in this Region. These storms caused 113 fires on the Nezperce, 93 on the Kaniksu, and 45 on the Clearwater Forest. The principal reason that none of these became large on the National Forests was the anticipatory action taken July 10-20 on the basis of fire danger measurements. If the protective organization had not been expanded when it was, it would have been impossible to have controlled all these fires before the fuels again dried to high inflammability on July 27, 28, 29, and 30.

The unusually late duration of fire danger, until October 11, warrants some description because it necessitated some exceptional presuppression expenditures. At Spokane, there has not been a September since 1888 which brought less rainfall than September 1935. Only 0.05 inch was reported for the entire month. At the Priest River Experiment Station only one other September, since 1911, has been drier than September 1935. Maximum temperatures above 80° were common throughout the month and the fuels were, therefore, dry and inflammable. As a result of these conditions, many Forests reported Class Four fire danger during the last ten days of September and for a few days in October. With such danger known to be existent and with the added exposure to slash burning by local ranchers, which began October 1, many of the protective positions which had been discontinued with the occurrence of light rains on September 15 had to be remanned.

Considering all these conditions, especially the occurrence of Class Seven danger on 17 different ranger districts where conditions were ripe for another $250,000 fire like the Freeman Lake conflagration, the Region One National Forest records for 1935 show a high degree of efficiency of fire control.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

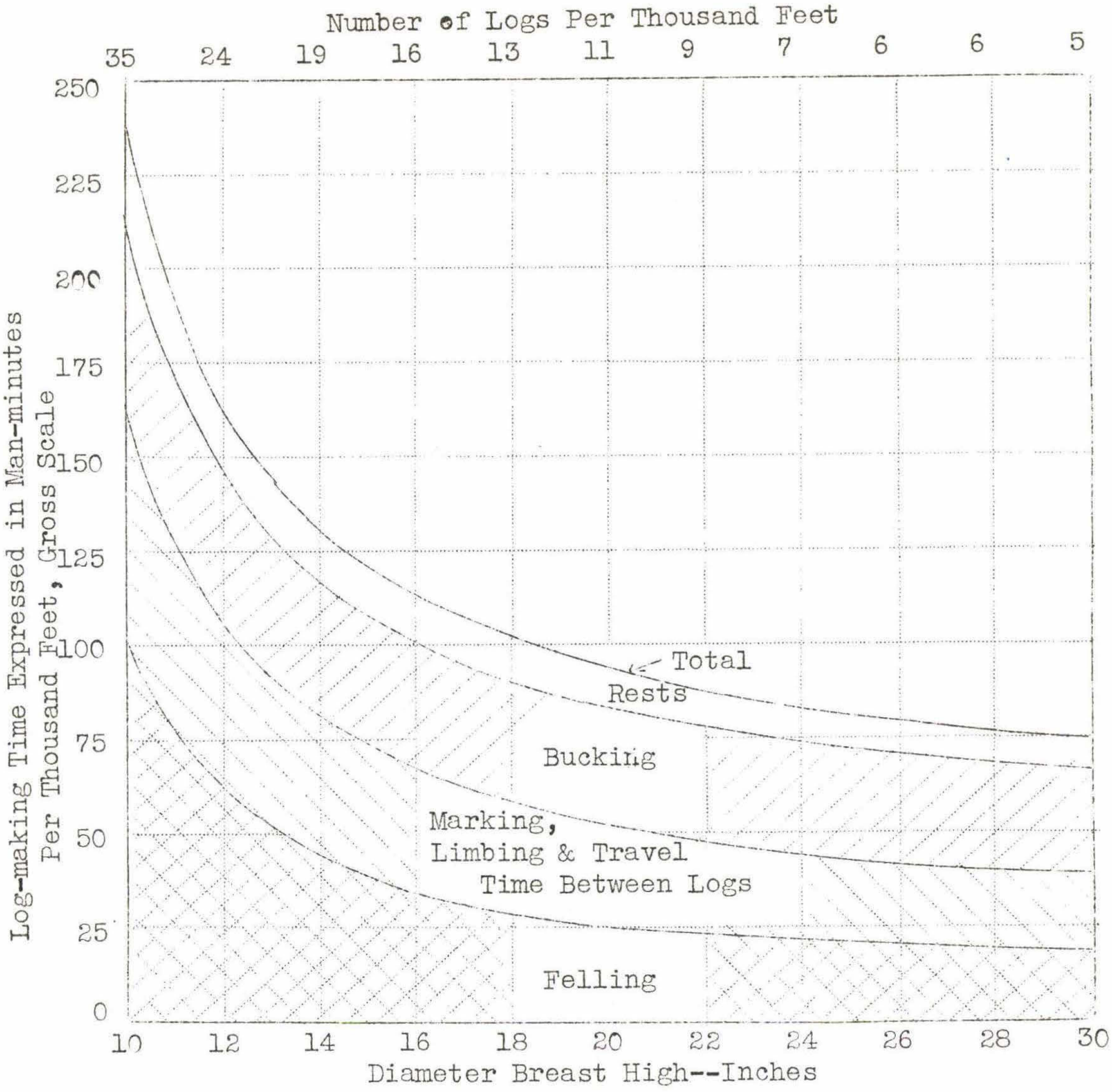
No. 74 Missoula, Montana April 15, 1936

Relation of Tree Size in Western White Pine to Log-Making Costs

By
E. F. Rapraeger, Associate Forester

This digest of log-making costs is part of a major study by the Station of the economics of timber exploitation in western white pine forests. Companion studies now under way deal with size-to-cost relationships in skidding, loading, hauling, and other tasks in a logging operation. Studies in the sawmill will show the cost of manufacture for trees and logs of different sizes and qualities and also the amount, grade, and value of lumber cut from them. With such information at hand, it will be possible to ascertain better than ever before the stumpage conversion value of a tree standing in the woods and to show by scientific appraisal what trees or logs it is economically sound to utilize, which are handled at a loss, and whether any changes should be made in conventional cutting practices.

Experienced sawyers know in a general sort of way, that it takes them longer to manufacture a thousand feet of logs from small timber and that when they work in large timber output increases. Size of timber influences their output more than any other factor. The curves on the next page indicate this. They show that when trees 10 inches in diameter breast high are made into logs, it takes 236 man-minutes for every thousand feet of timber felled, whereas for 25-inch trees, only 81 man-minutes are needed. Thus the cost is three times as much in one case as in the other.



RELATION OF TREE DIAMETER TO LOG-MAKING COSTS

The above curves are based on time studies made near Orofino, Clearwater County, Idaho, in a stand of western white pine timber, 141 years of age. Felling data were obtained for 279 trees and bucking data for 1,648 cuts. Timber was felled in autumn of 1935 on slopes ranging from 0 to 40 percent. Brush and windfalls were of light to medium density. Timber volumes are based on the Scribner decimal C log rule. The basis of volume or gross scale, is the portion of the tree included between stump height and end of the last utilized log; included are merchantable logs, breakage, long-butts, and defects within utilized logs. To place costs on a net log scale basis, allowance must be made for cull and breakage.

Numerous applications can be made of the size-to-cost relationships shown by the curves. They can be used to compute the cost of log-making for a given logging chance if the volume of timber by size classes is known. Or rates of pay (piece work basis) can be calculated which will be fair to both employer and employee when sawyers work in different sizes of timber. Or estimates might be made of the profit or loss in handling different sizes and types of trees so that uneconomic practices and policies might be avoided.

In order to apply the cost-to-size relationships of the figure to a given area, it is necessary to know the average size of timber on the area. Then an answer can be obtained to certain practical problems of which the following are examples:

An operator wishes to know how much he should pay his sawyers per thousand feet for log-making. He wants them to earn an average of 60 cents per hour. The pay will be based on the net scale of logs; cull of all kinds will average 15 percent including breakage, long-butts, and internal defect. The timber averages 20 inches in diameter breast high or 11 logs per thousand feet.

Solution: Referring to the figure, the time needed for sawing a thousand feet, gross scale, from 20-inch trees is 93 man-minutes or in terms of net scale (defect 15 percent), it amounts to 93 increased by 15 percent, or 107 man-minutes. Since the average earnings of sawyers are to be 60 cents per hour, the value of one man-minute becomes 1 cent and the rate of pay should be $1.07 per thousand feet, net scale.

Likewise, log-making costs for small second-growth white pine averaging 20 logs per thousand feet can be computed. Referring to the figure, 20-log timber will require 137 man-minutes per thousand feet, gross scale. Assuming normal cull is 5 percent and the value of one man-minute is 1 cent, the cost on a net scale basis should be $1.44 per thousand feet.

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NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 75 Missoula, Montana May 15, 1936

What Percent of Tree Volume Is in Each Log of a Western White Pine Tree ?

By
E. F. Rapraeger, Associate Forester.

Of especial interest to timber cruisers are the following figures which show for western white pine trees, the percent of gross volume contained in the butt log, second log, and other logs, including the top log. The measurements on which the table is based were taken near Orofino, Clearwater County, Idaho, in a stand of western white pine timber approximately 140 years of age.

Percent of merchantable volume represented by butt log, second log, etc. for western white pine trees.
(Basis of volume: Scribner Dec. C. log rule)

Log position in tree	Number of 16-foot logs per tree						
	2	3	4	5	6	7	8
	(percent of gross merchantable volume)						
Butt	55	43	35	31	27	25	25
2	--	33	28	25	23	21	20
3	--	--	21	20	19	18	17
4	--	--	--	15	15	14	14
5	--	--	--	--	10	11	10
6	--	--	--	--	--	7	7
7	--	--	--	--	--	--	4
Top	45	24	16	9	6	4	3
Gross merch. volume	100	100	100	100	100	100	100

Based on 641 trees, 10 to 35 inches in diameter, from White Pine Lumber Company study plot.

The term "gross merchantable volume" as used in the table refers to the volume of wood between the stump and end of the last utilized log. It includes utilized logs and also all waste material such as breakage, cull logs, and defect within utilized logs.

The figures apply to all diameters of tree from 10 to 35 inches. The height of tree, expressed in terms of 16-foot logs, influences the percent of volume in different logs but diameter has little effect. A 3-log tree 16 inches in diameter at breast height has about the same percent of volume in the butt log as a 3-log tree which is 20 inches in diameter.

There are numerous applications of the figures in the above table. For example, they will help to answer a question like the following for a timber cruiser: If 1/5 of the butt logs on a given area are culled, what percent of total volume do they represent? Assume that the timber is 5 logs high: then by referring to the table, the percent of total volume represented by the butt log of a 5-log tree is found to be 31 percent. If 1/5 by number are culled, the percent of defect becomes 1/5 of 31 percent or 6.2 percent.

Take another example: in a stand of 6-log timber, it is found that the butt and second log are of clear quality, the next two logs are medium quality, and the last two logs are rough. What percent of total volume does each quality class represent? Referring to the 6-log column of the table, the percent by volume of clear logs amounts to 50 percent (27+23), the percent of medium quality logs, 34 percent (19+15), and the percent of rough logs, 16 percent (10+6).

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NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 76 Missoula, Montana November 1936

TEST OF PRUNING EQUIPMENT AND METHODS IN WESTERN WHITE PINE

By

Kenneth P. Davis,
Assistant Silviculturist.

To supply information on pruning equipment and methods most effective in different western white pine stands suitable for pruning, a number of types of pruning equipment were tested recently on the Deception Creek Experimental Forest. Practically no pruning has been done to date in western white pine.

Tools Used

The tools used are shown in Plate 1. All except tool 1 are common types probably manufactured by several firms. The manufacturers of the particular tools used will be furnished on request. A detailed description of each tool together with wholesale cost follows:

1. Tree trimmer. Designed primarily for trimming limbs from competing trees. The tool is mounted on a pole and cuts both on draw and thrust stroke like a chisel. Not made commercially.

2. Pole-pruning saw. Eighteen-inch slightly concave blade, 3.2 inches wide at base, with 5 saw points per inch, cutting on the draw stroke. Two of these saws were used; one with an 8-foot and one with a 13-foot handle. Cost: saw with 8-foot pole, $2.35; with 14-foot pole, $2.72.

3. Pole-pruning saw. Fourteen-inch concave blade, 2 inches wide at base, with 8 long and slender saw points per inch, cutting on the draw stroke. Socket for pole attachment. Blade detachable from socket and is adjustable to 3 angles. Two of these saws were used; one with an 8-foot and one with a 13-foot handle. Cost without pole, $1.50.

4. Hand-pruning saw. Pistol grip handle; 14-inch concave blade, 2 inches wide at base and tapering to two-thirds inch at tip, with 8 short saw points per inch, cutting on draw stroke. Cost $0.87.

5. Hand-pruning saw. Pistol grip handle; 12-inch concave blade, 2 inches wide at base and tapering to two-thirds inch at tip, with 8 long and slender saw points per inch, cutting on the draw stroke. Cost $0.93.

6. Hand-pruning saw. Twenty-inch straight blade (17 inches with teeth), 5 inches wide at base, 1½ inches wide at tip, with coarse log saw teeth - 2 cutters and a raker tooth per inch. Carpenter saw handle. Cost $1.65.

7. Hand-pruning saw. Twenty-inch straight blade (17 inches with teeth), 5 inches wide at base, 1½ inches wide at tip, with 7 saw points per inch, cutting mostly on the thrust stroke. Ordinary carpenter saw type of handle. Cost $1.40.

8. Hand pruner. One flatly beveled cutting edge. Cuts up to about 1½ inches. One-piece hickory handles inserted in steel sockets.

9. Hand pruner. Built like a bolt cutter with 2 cutting edges sharpened to the tip. One edge flatly beveled, permitting cutting close to tree. Works best on limbs around 3/4 inches, but will readily cut up to 1¼ inches. Twenty inches long over-all. Cost $3.00.

Description of Work Done

Pruning tests were made in three stands chosen to represent the range of tree sizes that may be advantageously pruned. Most of the actual pruning was done by four CCC boys, all totally unfamiliar with pruning work. As a consequence, output data are probably not indicative of what would be accomplished by experienced men working steadily all day. Comparisons between different tools and methods, the primary purpose of these tests, are significant, however, as in all instances each man used each tool or method the same number of times.

Twenty-Five-Year Old Reproduction, Sands Creek

This vigorous, semiopen-grown stand of almost pure pine represents approximately the best size at which pruning should be begun. All pruning was done from the ground and extended up the bole only as far as a man could reach, or about 7½ feet. Pruning to this height removed about 30 percent of the live crown, which is enough to remove at one time. The average diameter breast-high was 5.1 inches and the total height 30 feet. An average of 24 limbs 0.65 inches in diameter were removed per tree.

Four types of hand tools were used and time studies made on a number of trees pruned. Results were as follows:

Tool Number	Number of Trees Pruned	Number of Limbs Cut per Tree	Time per Tree (Seconds)	Time per Limb Cut (Seconds)
4	10	21.2	184	8.7
5	10	28.1	239	8.5
7	11	19.3	196	10.1
9	10	27.5	140	5.1

On the basis of time per cut which is the most accurate comparison in this instance, tool 9, the small pruner, was distinctly the fastest tool. The quality of the work was excellent, and the tool is easy to operate. There was sufficient shoulder on the tree bole at the point of limb attachment so that no difficulty was experienced in making the cut sufficiently close to the bole. There was a slight tendency, however, to make cuts too far from the bole through trying to reach around the tree or not placing the tool properly. The tool can cut limbs up to 1¼ inches in diameter. Tools 4 and 5 were very effective, and both are thoroughly satisfactory for this work. An important advantage of the saw over the pruner is that any size of limb can be cut. Tool 7 was slower than the other two saws for the reason that the wide blade is not so easy to manipulate among branches close together, and, as it cuts on the thrust stroke, it is more fatiguing to operate on limbs higher than the shoulder. All in all, any of tools 4, 5, and 9 are fully satisfactory for this type of stand. The saws, however, are more versatile and considerably less expensive, even though not quite so fast as tool 9 in this particular stand. Tool 8, the large hand pruner, was not satisfactory for this work. The tool is large and awkward to operate and will not cut close enough to the bole. It does not make so clean a cut as tool 9.

Forty-Five-Year Stand, Deception Creek

This rather dense stand has just reached the size where a full 16-foot log length can be pruned without injury to the tree. The limbs are small, averaging about a half-inch in diameter and are practically all dead within 10 feet above the ground. Average diameter of trees suitable for pruning was about 5.5 inches, total height 35 to 45 feet. Plate 2 shows a typical tree before and after pruning.

Both the ladder and the pole saw method of pruning were tested. Pruning in each case was done to a height of 17 feet. By the ladder method, limbs higher than could be reached from the ground (about 7.5 feet) were cut from a ladder. After a little experimentation, it was found that 11 feet was the best ladder length for the average man. By this method only a ladder and one tool, a hand saw, are required and one man can prune the entire tree.

By the pole saw method, limbs were cut in three stages: up to 7.5 feet by a hand saw, 7.5 feet to 13 feet by an 8-foot pole saw, and 13 to 17 feet by a 13-foot pole saw, thus necessitating three separate tools. In the conduct of the work it was found best to use only one tool per man.

The pole saw method was distinctly faster than the ladder method in this kind of stand. The limbs being small could be cut by means of a pole saw nearly as readily as by a hand saw operated from a ladder. The stand being dense, as are most such stands, a ladder was difficult to carry through the woods.

Tool 5 was preferred as a hand saw. It cuts fast, particularly dry limbs, is easy to operate, serviceable, and inexpensive. Tool 9, the pruner, was not satisfactory. It was difficult to make the cut sufficiently close to the bole as there was no swelling of the bole at the point of limb attachment, and the tool was not so fast as a hand saw on the numerous small dead limbs. Tools 4 and 7 did satisfactory work, but were not judged to be quite so good for the work as No. 5. The shorter teeth of these saws gum up with pitch more readily than No. 5.

Of the pole saws, No. 2 was judged superior to No. 3. The former is extremely well mounted, easy to operate, and does excellent work. No. 3, while a satisfactory tool, is not so well mounted - the socket and adjustable angle of the blade are of no advantage for this work and tend to work loose - and the blade has a little too much sweep to get a full stroke and has a tendency to catch in the cut and tear off the limb when nearly sawed through. Tool 1 was tested but not found satisfactory. It is fatiguing to operate and does not do good work.

Fifty-Year Stand, Searchlight Creek

This is an exceptionally thrifty stand of western white pine and ponderosa pine growing on an excellent site. Diameters of dominant trees range from 10 to 17 inches and heights from 60 to 75 feet. Trees are well spaced and about as limby as can be found in good quality western white pine stands. Live limbs begin at from 10 to 25 feet above the ground. Below these, dead limbs remain solidly attached to the bole practically to the ground. See Plate 3. While this stand has obviously long passed the best pruning size, pruning is still probably worth while, as it is very likely that such a fast-growing stand will be left uncut until the better trees are around 30 inches in diameter.

Both the ladder and pole saw methods were employed. The results of a number of time tests on white pine trees indicated that there was little, if any, difference in speed. By each method it took a trifle over 7 minutes to prune a tree, counting working time only. An average of 50 limbs 0.76 inches in diameter was cut per tree. It was unanimously agreed, however, that the ladder method was distinctly less tiring and would be the preferable method day in and day out in such timber. The principal reason is that the largest limbs are the highest from the ground, and these larger limbs can be cut much more easily with a hand saw from a ladder than with a pole saw operated from the ground. Also, the stand being fairly open, a ladder could be readily moved from tree to tree. Tools 2 and 5 were again found to be the most satisfactory.

A few ponderosa pine trees were also pruned. These trees had considerably larger limbs than the white pine, many of them, especially the higher ones, being 1½ to 2 inches in diameter. On these trees the ladder method was found to be decidedly faster and easier than the pole saw method. Cutting these larger limbs with a pole saw was found to be slow and tiring work. Tool 6, the "Champion-tooth" hand saw, was found to be the best tool for this work.

Recommendations

The best all-around tool of the group tested was tool 5, the 12-inch hand saw. This saw is inexpensive, serviceable, and thoroughly satisfactory. The use of the hand pruner, tool 9, is limited and the tool much more expensive. Tool 4 is nearly as good as No. 5 - to some there is little difference. Tool 7 is a little more expensive and is not so satisfactory as either 4 or 5. Tool 6 is recommended where the majority of the limbs are more than 1½ inches in diameter. Tools 1 and 8 are not recommended.

The pole saw recommended is tool 2.

For most high pruning work in western white pine, the pole saw seems preferable to the ladder method. The latter method is advisable only where limbs to be cut, particularly the higher ones, are large - many of them over an inch in diameter - and where the density of the stand is such that a ladder can be transported with reasonable ease through the woods.

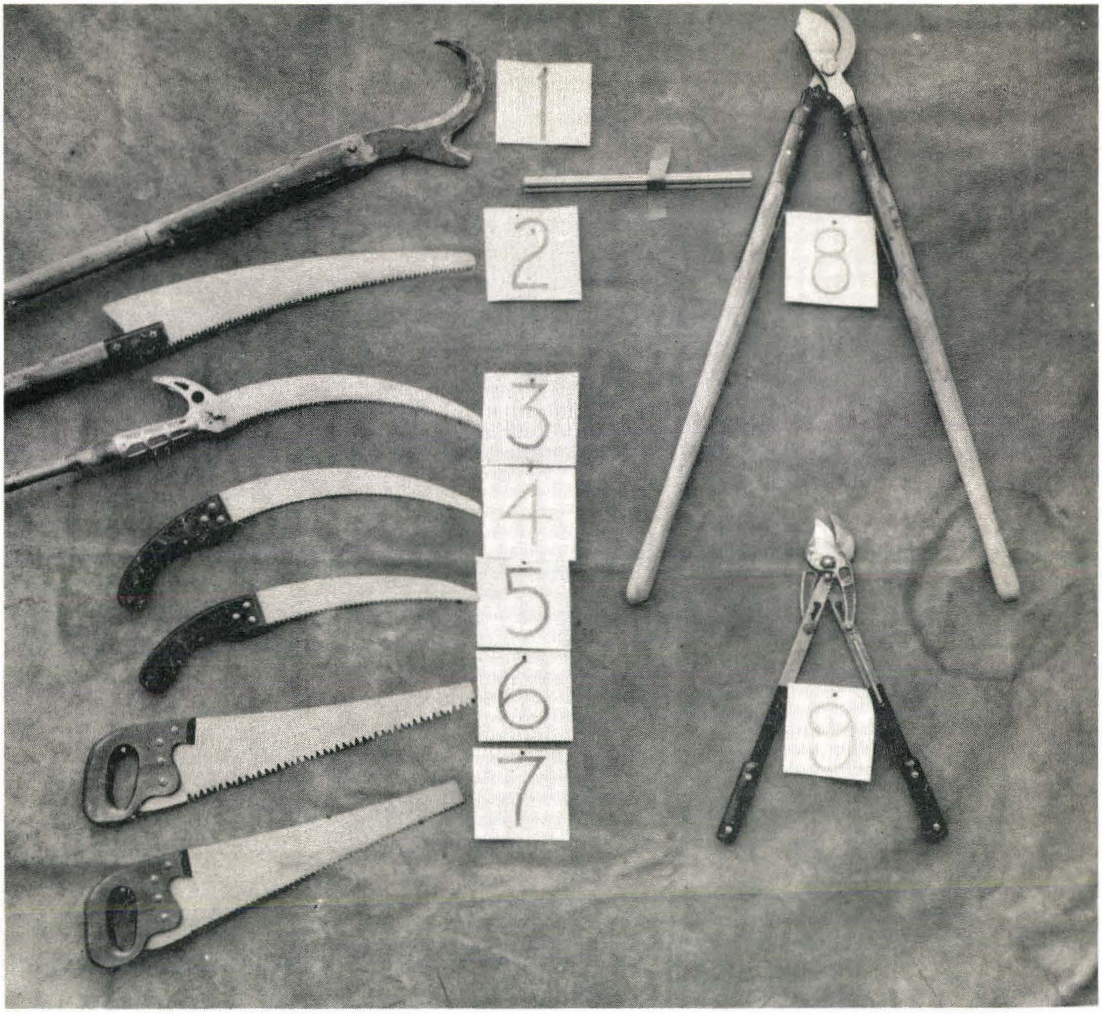
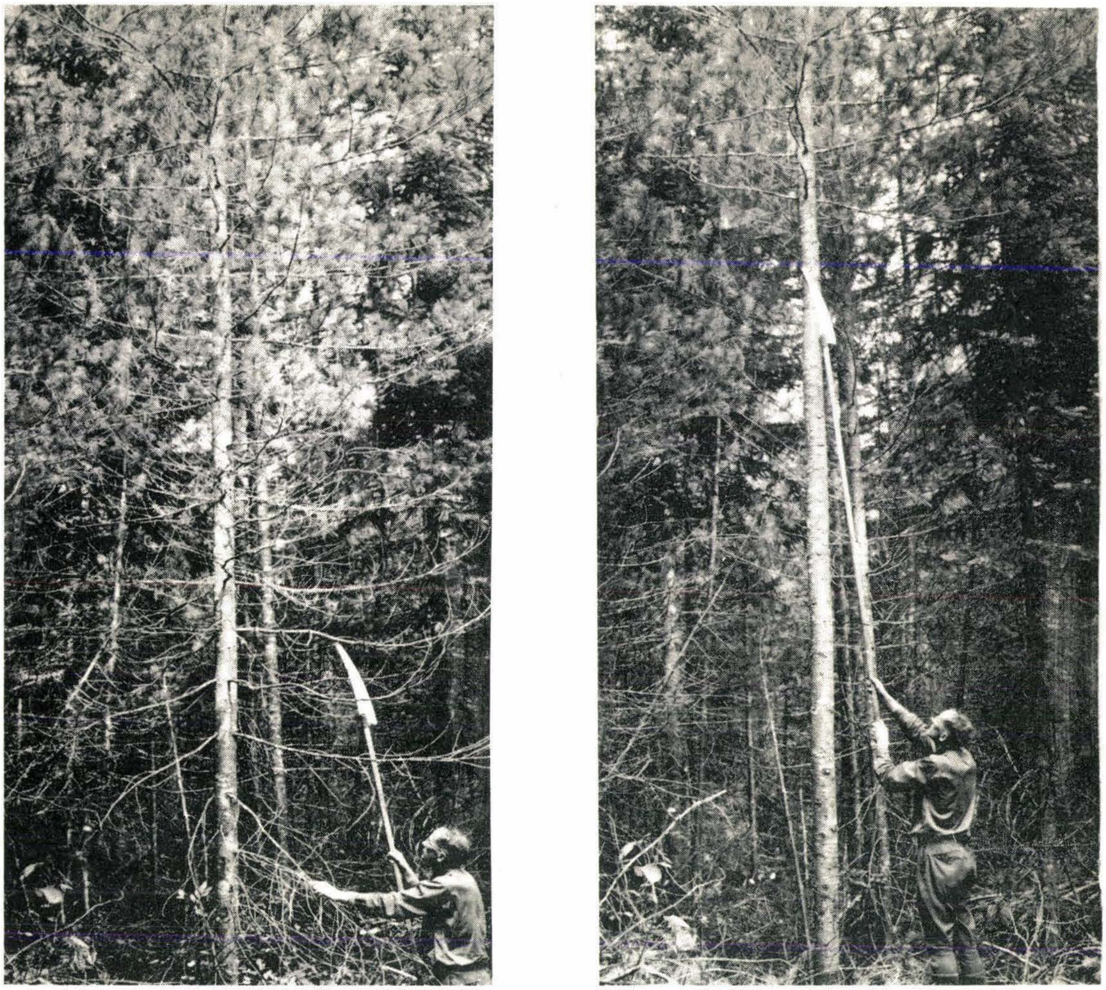
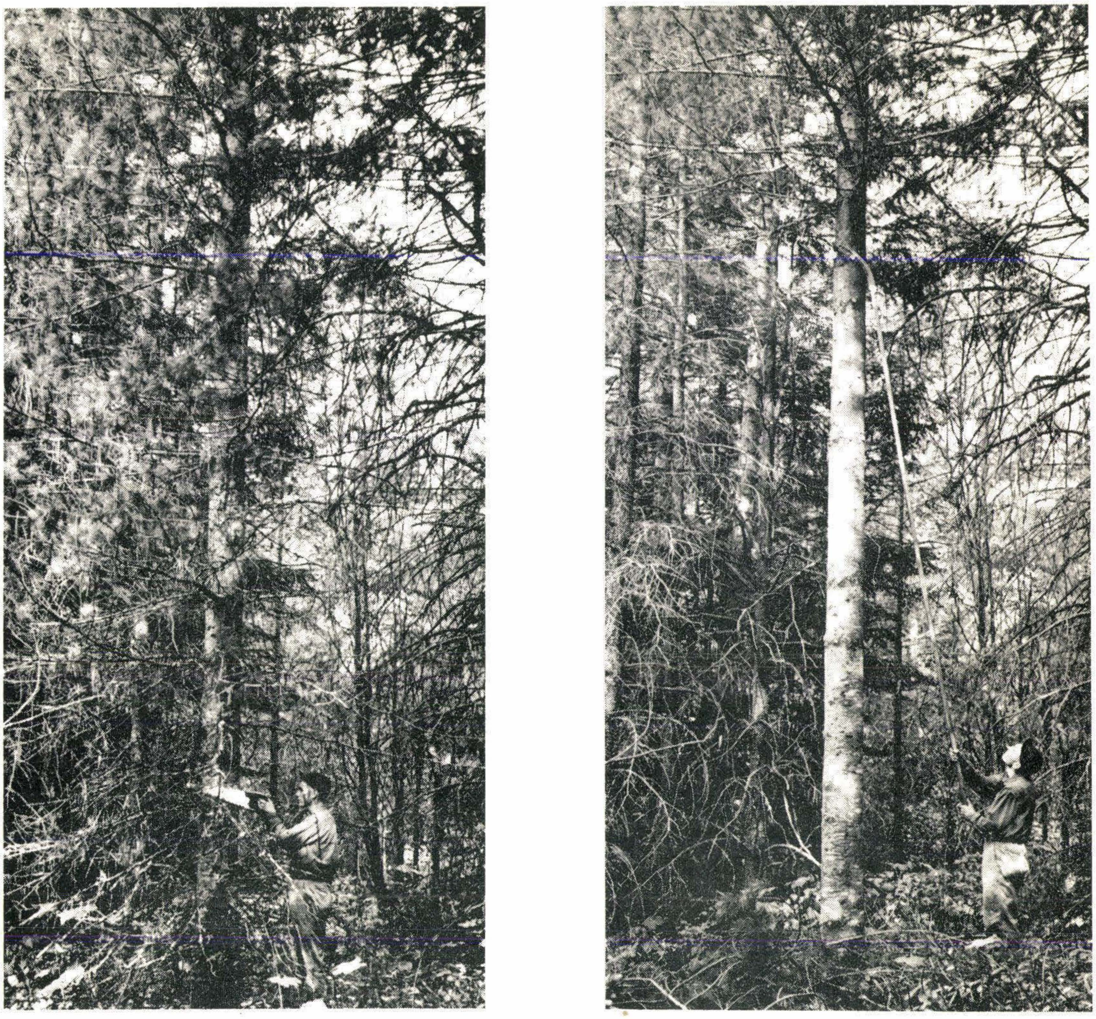


Plate 1.--Pruning tools used.



Before pruning After pruning

Plate 2. Pruning in 40-year-old western white pine. Deception Creek Experimental Forest, Idaho.



Before pruning

After pruning

Plate 3.--Pruning in 50-year-old western white pine. Searchlight Creek, Coeur d'Alene National Forest, Idaho.

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NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 77 December, 1936 Missoula, Montana

THE CHARACTER OF THE 1936 FIRE SEASON IN REGION ONE

By

George M. Jemison, Assistant Forester

The 1936 fire season rated as critical in Montana and northern Idaho, according to the annual survey of Weather Bureau measurements and Forest Service fire danger records made by the Northern Rocky Mountain Forest and Range Experiment Station. The method outlined in Applied Forestry Note No. 67, of January, 1935, was followed in making this rating. The fire control organization was confronted with one of the most hazardous seasons ever experienced in eastern Montana. In western Montana and northern Idaho the season rates as critical but less so than the worst years such as 1919, 1929, and 1934. Weather Bureau records plus fuel moisture measurements at 83 stations, augmented by daily observations of wind velocity, visibility, and humidity at many more, furnish proof for these statements.

July and August, the two most critical months of every fire season, rated 81% of worst probable danger on the ten western fire Forests of Region One this year. This compares with 76% for the same period in 1935, 86% for 1934, which was a year of extreme danger, and 74% in 1933. The rather wide spread in the degree of danger on the different Forests for July and August of this year is indicated by the following rating which shows the percentage of worst probable danger: Kootenai and Lolo, 89%; Cabinet and Flathead, 85%; Kaniksu, 79%; Nezperce, 78%; Coeur d'Alene, 77%; Clearwater, 76%; St. Joe, 75%; and Bitterroot, 73%.

Due to the absence of fire danger stations, similar ratings are not available for the Montana Forests lying from the Continental Divide eastwards. However, Weather Bureau precipitation, temperature, and humidity records indicate that the danger in the north-central and southeast sections approached the worst on record. Evidence of the severity of the season is indicated by records from approximately 110 Montana Weather Bureau stations which show that the period May to July, inclusive, this year, for the entire State was surpassed in dryness by only one year, 1919, since Statewide records began in 1895. The period May to July, this year, was the hottest throughout Montana since inception of weather measurements and during the month of July maximum temperatures equaled or exceeded the all-time records at 36 stations. Relative humidity was below average in the drier zones of eastern Montana. This was especially true in the southeast section as evidenced by the 6:00 p.m. records for Miles City. Here humidity averaged but 58% of normal for the four months, June to September. For 15 consecutive days starting June 26, the 6:00 p.m. humidity was 20% or lower.

Critical seasons can always be identified by extended periods of high fire danger when the absence of favorable "breaks" makes the job of fire control exceptionally difficult. The attached chart shows the daily fire danger by individual Forests, and indicates in detail some of these critical periods in northern Idaho and western Montana during the 1936 fire season. For example, the Kaniksu Forest had Class 5 fire danger 1/ from July 18 to August 17 (31 days) interrupted by only two days of lesser danger. From July 13 to August 17, the Kootenai Forest had only one day below Class 5 fire danger and 17 days of this 36-day period rated as Class 6. The Lolo Forest experienced 42 days of Class 5 and 6, interrupted by seven days of lesser danger. Similar extended periods of critical danger occurred on other Forests.

Abundant June rains over most of northern Idaho and western Montana delayed the approach of critical conditions, and favorable "breaks" in the form of spotted showers came at about 20-day intervals to the Bitterroot, Clearwater, and Nezperce Forests. All Forests but the Bitterroot, Nezperce, and Lolo received good rains on August 24 and 25, and all ten fire Forests were covered by general precipitation September 1 to 4. It varied greatly in amount over the territory.

1/ Classes 5, 6, and 7 of fire danger represent combinations of conditions conducive to rapidity of spread of fire and difficulty of control that cannot be met by the average season protective organization.

While the rains of early September ended the fire season on north slopes and on heavily timbered areas in most of the western part of the Region, rapid drying weather that followed caused high danger to develop on south slopes and burns. Conditions were conducive to rapid spread of fire on such sites through October and even into November.

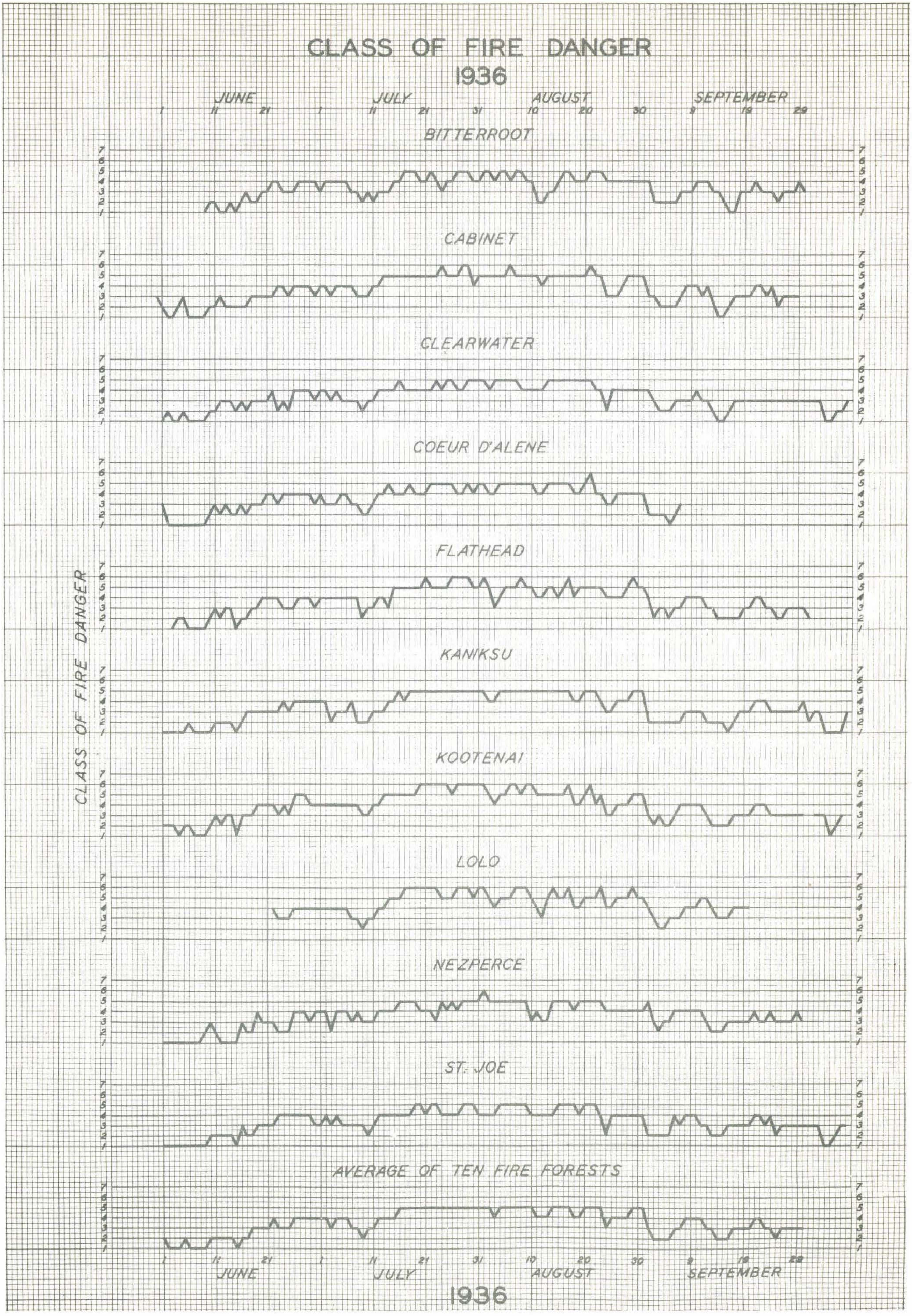
The late season danger is reflected by the precipitation records at 18 northern Idaho forest or adjacent stations which received from 6 to 56% of normal rainfall for October with the average catch per station but 23% of normal. Never before has such a dry October been recorded at the Priest River Experiment Station and only one October since 1893 has been drier over the northern part of Idaho as a whole. This exceptional condition was even worse than the fall of 1935 and also necessitated excessive presuppression expenditures.

Although the frequency of the occurrence of lightning storm days was exactly normal for the period June 21 to September 10, inclusive, the regularity of the disturbances during peak danger periods was another feature that marked the 1936 fire season as critical. From July 16 to August 23, inclusive, lightning storms occurred on 27 of the possible 39 days somewhere on the ten fire Forests of the Region. However, one favorable feature of the past season was that few large concentrations of lightning fires occurred on any one Forest on any one day. The unprecedented number of lightning fires that occurred this year, 1362, were fairly well scattered, 29 being the greatest number reported by a single Forest in one day.

Weather Bureau records indicate, in general, that wind velocities were normal or slightly below normal during the 1936 season. Fewer days of extreme velocity reduced the probability of fires making big runs and helped prevent catastrophies that might have occurred during the extreme July and August periods.

In Region One the Forest Service fire suppression organization controlled 1716 fires during the past season. In spite of conditions that averaged 81% of worst probable fire danger during July and August, only 4% of these fires reached a size of 10 acres or larger.

CLASS OF FIRE DANGER
1936



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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 78 Missoula, Montana April, 1937

LARCH-DOUGLAS FIR BOARD-FOOT YIELD TABLES

By L. J. Cummings, Assistant Forester.

A study of growth rates and yields of forest areas in the larch-Douglas fir type was recently made by the Northern Rocky Mountain Forest and Range Experiment Station. Since this is the first study of this nature to be made for the type, the resultant yield tables will be of interest and practical value to forest owners and those concerned with problems of land use planning.

The attached yield table shows gross board foot volume per acre at ten-year age intervals for each of five site classes, showing yields per acre for areas supporting stands of varying degrees of stocking.

Discussion of the tables is limited here to a brief outline of the method of their application.

For any given stand, the growth of which is to be predicted, the following information must be determined:

1. Age
2. Site quality
3. Stocking percent

Age determination

Total age of a tree is indicated by the number of growth rings developed at the root crown (i.e. at ground level). This is determined by counting the rings on a stump or other convenient section of the tree and adding to this the age required to reach the height at which the count is made. The number of years to be added for any height can be easily found by cutting a few seedlings or saplings on the area and observing the difference in age at ground level and point of count. An addition of 3-5 years will be found approximately correct for stump heights of one and one-half to two and one-half feet.

The average age of the dominant and codominant trees which represent the greater portion of the volume should be taken as the age of the stand. Occasional old veterans or relics in the stand should not be considered in the determination of this average age.

Site quality determination

Site quality is the relative wood-producing capacity of a given area.

To apply yield table values to any area it is necessary to classify it as to site quality so that the correct table may be used. This is done by determining the average height of dominant and codominant trees now growing upon the area and referring to the attached site classification curves which are based on the average height growth of dominant and codominant trees at various ages. For example, the dominant and codominant trees in a given 100-year old stand average 97 feet tall. On the site classification chart plot the height on the given age. The curve nearest which the plotted point falls indicates the proper site quality of the area, which in this case is site quality III.

The average total height of 10 or 15 representative dominant and codominant trees is usually sufficient for site quality determination.

Stocking percent determination

Stocking is the extent that areas are utilized by tree growth, taking into consideration number, size and distribution of trees on the area. Stocking percent is the measure of the relative degree an area is stocked as related to fully stocked or 100 percent stocked areas. The values shown in the tables for the 100 percent stocked areas can be attained only on selected areas of an acre or less. For this reason fairly well stocked stands occurring over larger areas will usually average less than 75 percent stocked.

The most satisfactory means of estimating stocking is by average volume per acre. This may be determined by ordinary cruising methods, making no allowance for defect or breakage.

The tables presented here show yields per acre covering the range of stocking percentages for the given site class and age. The stocking percent of an area may be read directly from the tables by finding in the appropriate table for the site class represented the value that equals the volume per acre obtained by the cruise. For example: A stand of larch-Douglas fir, site III, 150 years old, has an average volume per acre of 20,280 board feet gross scale. In the site III table, opposite age 150 the tabular volume 20,280 is read in the 60 percent column indicating that the area is 60 percent stocked.

Intermediate stocking values may be obtained by computing the ratio between the average volume per acre and the tabular 100 percent value. For example: Given a 150-year old stand, site III, with an average volume per acre of 16,900 board feet. The 100 percent value at that site and age is 33,800. Stocking percent is $\frac{16900}{33800}$ or 50 percent.

Use of tables for predicting future yields

The yield of a stand ten years in the future may be predicted from the yield tables simply by adding ten years to the present age of the stand and reading from the table the yield at that age, degree of stocking, and site predetermined by the above described methods. For example: Given a stand of larch-Douglas fir, site III, 150 years old, and 60 percent stocked. The owner desires to know the yield of the stand ten years hence. Age of stand ten years hence is 160 years. Site and stocking remain the same. Estimated yield as shown by the table is 22,860 board feet.

Intermediate values of the yield table are easily obtained in interpolation. For example: The yield of a 95-year old stand of larch-Douglas fir, site III, 60 percent stocked, may be computed as follows:

1. Yield at 90 years equals 4,860 board feet
2. " " 100 " " 6,720 " "
3. Difference between yield at 90 and 100 years equals 1,860 board feet
4. Growth for 1 year is 1,860 ÷ 10 or 186 board feet
5. Growth for 5 years is 186 x 5, or 930 board feet
6. Yield at 95 years equals the yield at 90 years plus growth for 5 years, i.e., 4,860 + 930, or 5,790 board feet.

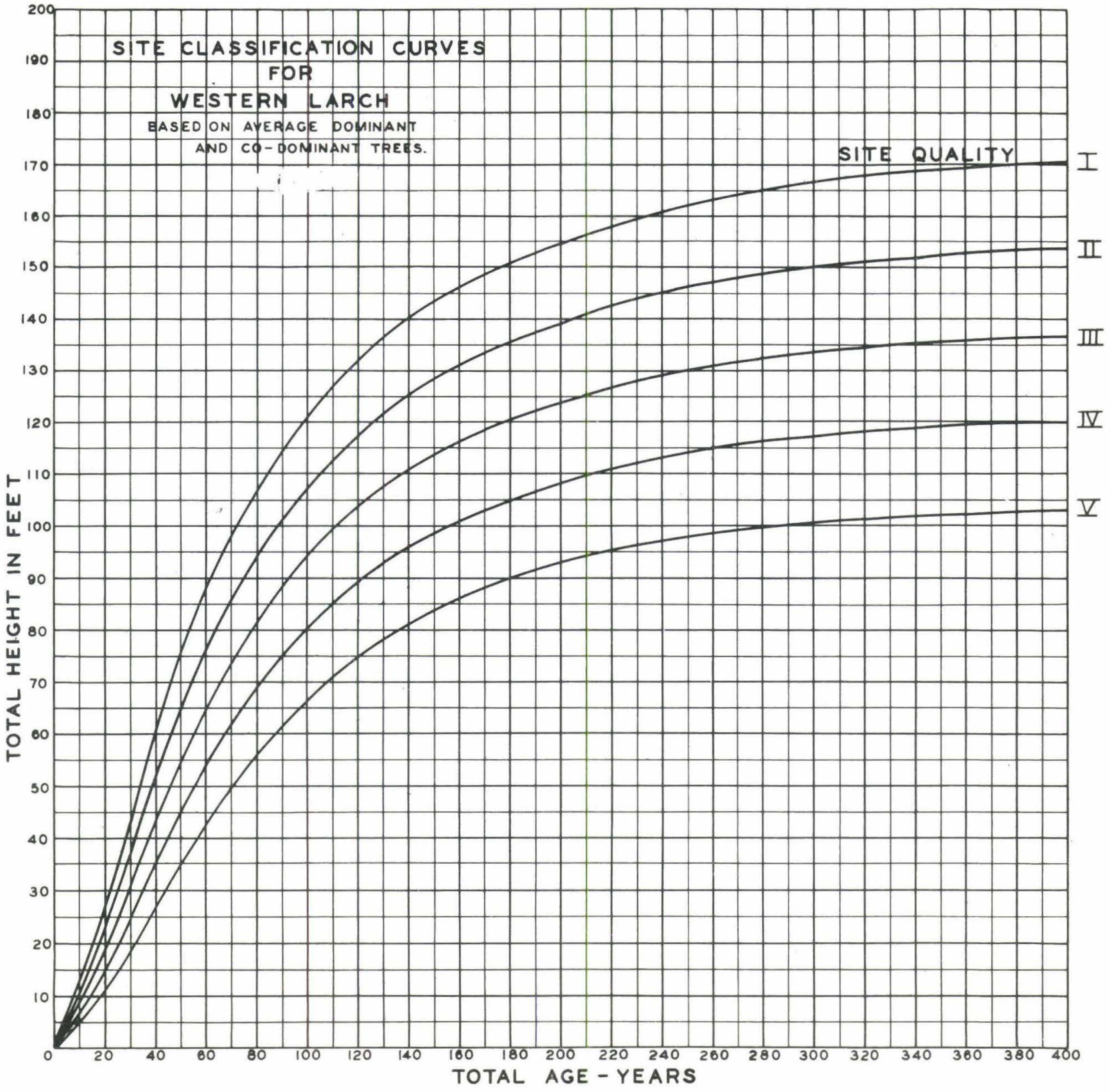
Allowances for breakage or defect which have not been made in these tables must be estimated separately for each stand and the yield values reduced accordingly.

RE-NRM
Forest Survey
Growth Phase

BOARD-FOOT VOLUME PER ACRE IN TREES 13.0 INCHES D.B.H. AND LARGER

Scribner Rule to Merchantable Top

Total age	Site I Percent Stocked					Site II Percent Stocked					Site III Percent Stocked					Site IV Percent Stocked					Site V Percent Stocked				
Years	100%	80%	60%	40%	20%	100%	80%	60%	40%	20%	100%	80%	60%	40%	20%	100%	80%	60%	40%	20%	100%	80%	60%	40%	20%
40	500	400	300	200	100																				
50	3400	2720	2040	1360	680	1200	960	720	480	240	100	80	60	40	20										
60	8000	6400	4800	3200	1600	3800	3040	2280	1520	760	1400	1120	840	560	280	40	32	24	16	8					
70	14500	11600	8700	5800	2900	7500	6000	4500	3000	1500	3200	2560	1920	1280	640	800	640	480	320	160					
80	22900	18320	13740	9160	4580	12200	9760	7320	4880	2440	5400	4320	3240	2160	1080	1700	1360	1020	680	340					
90	33900	27120	20340	13560	6780	18000	14400	10800	7200	3600	8100	6480	4860	3240	1620	2800	2240	1680	1120	560	70	56	42	28	14
100	43500	34800	26100	17400	8700	25400	20320	15240	10160	5080	11200	8960	6720	4480	2240	4000	3200	2400	1600	800	300	240	180	120	60
110	51400	41120	30840	20560	10280	33100	26480	19860	13240	6620	14900	11920	8940	5960	2980	5300	4240	3180	2120	1000	600	480	360	240	120
120	58200	46560	34920	23280	11640	39800	31840	23880	15920	7960	19200	15360	11520	7680	3840	6800	5440	4080	2720	1360	1000	800	600	400	200
130	64300	51440	38580	25720	12860	45800	36640	27480	18320	9160	24100	19280	14460	9640	4820	8400	6720	5040	3360	1680	1500	1200	900	600	300
140	69800	55840	41880	27920	13960	51200	40960	30720	20480	10240	29100	23280	17460	11640	5820	10200	8160	6120	4080	2040	2000	1600	1200	800	400
150	74800	59840	44880	29920	14960	56000	44800	33600	22400	11200	33800	27040	20280	13520	6760	12100	9680	7260	4840	2420	2600	2080	1560	1040	520
160	79500	63600	47700	31800	15900	60400	48320	36240	24160	12080	38100	30480	22860	15240	7620	14100	11280	8460	5640	2820	3200	2560	1920	1280	640
170	83800	67040	50280	33520	16760	64400	51520	38640	25760	12880	42000	33600	25200	16800	8400	16200	12960	9720	6480	3240	3900	3120	2340	1560	780
180	87700	70160	52620	35080	17540	68100	54480	40860	27240	13620	45500	36400	27300	18200	9100	18400	14720	11040	7360	3680	4600	3680	2760	1840	920
190	91300	73040	54780	36520	18260	71500	57200	42900	28600	14300	48700	38960	29220	19480	9740	20700	16560	12420	8280	4140	5300	4240	3180	2120	1060
200	94600	75680	56760	37840	18920	74500	59600	44700	29800	14900	51600	41280	30960	20640	10320	23100	18480	13860	9240	4620	6000	4800	3600	2400	1200
210	97600	78080	58560	39040	19520	77300	61840	46380	30920	15460	54200	43360	32520	21680	10840	25500	20400	15300	10200	5100	6600	5280	3960	2640	1320
220	100300	80240	60180	40120	20060	79800	63840	47880	31920	15960	56600	45280	33960	22640	11320	27800	22240	16680	11120	5560	7200	5760	4320	2880	1440
230	102800	82240	61680	41120	20560	82100	65680	49260	32840	16420	58800	47040	35280	23520	11760	29900	23920	17940	11960	5980	7800	6240	4680	3120	1560
240	105100	84080	63060	42040	21020	84200	67360	50520	33680	16840	60800	48640	36480	24320	12160	31900	25520	19140	12760	6380	8300	6640	4980	3320	1660
250	107200	85760	64320	42880	21440	86200	68960	51720	34480	17240	62600	50080	37560	25040	12520	33700	26960	20220	13480	6740	8800	7040	5280	3520	1760
260	109200	87360	65520	43680	21840	88000	70400	52800	35200	17600	64300	51440	38580	25720	12860	35400	28320	21240	14160	7080	9300	7440	5580	3720	1860
270	111100	88880	66660	44440	22220	89700	71760	53820	35880	17940	65800	52640	39480	26320	13160	36900	29520	22140	14760	7380	9800	7840	5880	3920	1960
280	112800	90240	67680	45120	22560	91200	72960	54720	36480	18240	67200	53760	40320	26880	13440	38300	30640	22980	15320	7660	10200	8160	6120	4080	2040
290	114400	91520	68640	45760	22880	92600	74080	55560	37040	18520	68500	54800	41100	27400	13700	39600	31680	23760	15840	7920	10600	8480	6360	4240	2120
300	115900	92720	69540	46360	23180	93900	75120	56340	37560	18780	69700	55760	41820	27880	13940	40800	32640	24480	16320	8160	11000	8800	6600	4400	2200
310	117300	93840	70380	46920	23460	95100	76080	57060	38040	19020	70800	56640	42480	28320	14160	41900	33520	25140	16760	8380	11400	9120	6840	4560	2280
320	118600	94880	71160	47440	23720	96200	76960	57720	38480	19240	71800	57440	43080	28720	14360	42900	34320	25740	17160	8580	11800	9440	7080	4720	2360
330	119800	95840	71880	47920	23960	97300	77840	58380	38920	19460	72800	58240	43680	29120	14560	43800	35040	26280	17520	8760	12200	9760	7320	4880	2440
340	120900	96720	72540	48360	24180	98300	78640	58980	39320	19660	73700	58960	44220	29480	14740	44700	35760	26820	17880	8940	12600	10080	7560	5040	2520
350	121900	97520	73140	48760	24380	99200	79360	59520	39680	19840	74500	59600	44700	29800	14900	45500	36400	27300	18200	9100	12900	10320	7740	5160	2580
360	122800	98240	73680	49120	24560	100100	80080	60060	40040	20020	75300	60240	45180	30120	15060	46300	37040	27780	18520	9260	13200	10560	7920	5280	2640
370	123700	98960	74220	49480	24720	100900	80720	60540	40360	20180	76000	60800	45600	30400	15200	47000	37600	28200	18800	9400	13500	10800	8100	5400	2700
380	124500	99600	74700	49800	24900	101700	81360	61020	40680	20340	76700	61360	46020	30680	15340	47700	38160	28620	19080	9540	13800	11040	8280	5520	2760
390	125200	100160	75120	50080	25040	102400	81920	61440	40960	20480	77300	61840	46380	30920	15460	48200	38560	28920	19280	9640	14100	11280	8460	5640	2820
400	125900	100720	75540	50360	25180	103100	82480	61860	41240	20620	77900	62320	46740	31160	15580	48700	38960	29220	19480	9740	14400	11520	8640	5760	2880


SITE CLASSIFICATION CURVES
FOR
WESTERN LARCH
BASED ON AVERAGE DOMINANT
AND CO-DOMINANT TREES.
SITE QUALITY
I
II
III
IV
V
TOTAL HEIGHT IN FEET
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
TOTAL AGE - YEARS

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 79 Missoula, Montana April, 1937

GROWTH AFTER LOGGING OF LARCH-DOUGLAS FIR STANDS IN NORTHWESTERN MONTANA

Prepared by the Division of Silvics

Growth-after-logging studies for partially cut stands of larch-Douglas fir in northwestern Montana have been recently completed, furnishing for the first time definite information on growth of partially cut stands. 1/ Such information is necessary to predict the volume to be expected at a second cut and should be of particular interest to timberland operators in the larch-fir forests.

Table 1 shows volumes per acre to be expected 10, 20, 30, and 40 years hence when various initial volumes per acre are left after logging. The large increase in volume during the third and fourth decade is caused in part by the large number of pre-merchantable trees, present at the time of logging, that subsequently attained merchantable size. As used in this study lower merchantable limits are: Western larch, 13.1 inches; Douglas fir, lodgepole pine, and ponderosa pine, 11.1 inches; and Engelmann spruce and lowland white fir, 9.1 inches d.b.h. On the average, there were 32 pre-merchantable trees per acre, of all species, which reached merchantable size in 30 years after logging, and 42 trees in 40 years after logging. Volume added by these trees constitutes an important part of the total volume growth made by these stands since logging. In applying these figures, it must be remembered that they are averages based on a number of cut-over stands. Volumes attained by individual stands may exceed or fall short of the averages given in the table.

1/ This note is prepared to make the most important results of the study immediately available. A more complete report will be issued later.

Table 2 shows for western larch, Douglas fir, and Engelmann spruce diameter growth by 10-year periods of trees of a given diameter class at the time of logging.

The study is based on an analysis of growth on 86 sample plots. These plots were located near the junction of Swan Lake and the lower Swan River, and along the Stillwater River west of Kalispell, Montana, and are representative of cuttings made in the larch-fir forests 20 to 40 years ago. Most of the plots were located on fair to good sites. On each plot detailed measurements of each tree were made to determine volume and diameter growth. Average composition of the stands left after logging was Douglas fir 49 percent, western larch 30 percent, Engelmann spruce 15 percent, lowland white fir 3 percent, lodgepole pine 2 percent, and ponderosa pine 1 percent.

Mortality in these stands was found to be very low, averaging only 2 percent for a 30 to 40-year period following logging.

Table 1.--Board-foot volume growth, Scribner rule, in partially cut stands of larch-Douglas fir, site qualities good to fair

	Volume of reserve stand per acre			
Reserve stand at time of cutting	After an interval of			
	10 years	20 years	30 years	40 years
Board feet	Board feet	Board feet	Board feet	Board feet
500	1,010	2,350	4,500	7,350
750	1,500	3,050	5,200	8,050
1,000	1,900	3,600	5,800	8,650
1,250	2,250	4,100	6,300	9,100
1,500	2,600	4,500	6,750	9,550
1,750	2,900	4,900	7,200	9,950
2,000	3,200	5,250	7,450	10,300
2,250	3,500	5,600	7,750	10,650
2,500	3,750	5,900	8,050	10,950
2,750	4,000	6,200	8,350	11,200
3,000	4,300	6,500	8,600	11,500
3,250	4,500	6,800	8,850	11,750
3,500	4,800	7,000	9,100	12,000
3,750	5,050	7,300	9,350	12,250
4,000	5,300	7,550	9,600	12,500
4,250	5,550	7,800	9,800	12,750
4,500	5,850	8,100	10,050	13,000
4,750	6,200	8,350	10,300	13,250
5,000	6,400	8,600	10,500	13,500
5,250	6,700	8,900	10,750	13,750
5,500	7,000	9,200	11,000	14,000

Table 2.--Average diameter breast high in inches, before and after partial cutting of the stand, for western larch, Douglas fir, and Engelmann spruce, growing on fair to good sites

Diameter at indicated number of years before cutting		Diameter at time of cutting	Diameter at indicated number of years after cutting			
20 years	10 years		10 years	20 years	30 years	40 years
			Western Larch			
		4.0	5.2	6.6	7.9	
5.2	5.7	6.0	6.6	7.7	8.7	9.4
7.1	7.6	8.0	8.8	10.1	11.3	12.2
8.7	9.4	10.0	10.9	12.1	13.1	13.9
10.8	11.4	12.0	12.8	14.1	14.9	15.9
12.6	13.3	14.0	15.0	15.9	16.8	18.1
14.6	15.3	16.0	16.9	18.1	19.0	19.7
			Douglas Fir			
0.9	1.6	2.0	3.1	4.7	6.2	7.1
2.6	3.4	4.0	4.8	6.1	7.1	7.9
4.7	5.4	6.0	6.7	7.7	8.5	9.3
6.7	7.4	8.0	8.9	9.9	10.8	11.8
8.6	9.4	10.0	11.0	12.2	12.9	13.7
10.4	11.3	12.0	13.1	14.2	15.1	17.0
12.3	13.3	14.0	15.2	16.4	17.2	17.9
14.2	15.2	16.0	17.2	18.2	18.9	19.9
			Engelmann Spruce			
0.7	1.5	2.0	3.9	5.8	7.8	8.7
2.9	3.6	4.0	5.1	6.9	8.5	9.4
4.5	5.3	6.0	7.3	9.3	10.6	11.8
6.4	7.3	8.0	9.4	11.1	12.2	12.8
7.7	8.9	10.0	11.5	13.0	13.9	14.4
10.4	11.2	12.0	13.5	14.9	15.7	16.7

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 80 Missoula, Montana April, 1937

VARIATIONS OF SOME FIRE DANGER FACTORS WITH ALTITUDE, ASPECT, AND TIME OF DAY.

By G. L. Hayes, Junior Forester.

When a fire dispatcher receives the definite location and estimated perimeter of a new fire there are several things which he must consider before deciding how many men to send. Two outstanding factors are rate at which the fire will spread and resistance it will offer to control. Resistance to control can be approximated from the forest fuel type map which also shows rate of spread if the day is fairly bad, or class 5 in character. It does not give rate of spread for other danger classes.

Variations in wind, fuel moisture, or humidity may be so great, even within the limits of a class 5 day, that rate of spread will not be as indicated by the fuel type map. Efficient dispatching, therefore, requires information concerning each of these factors and the resultant class of fire danger at the spot where the fire is located.

About 100 inflammability stations in Region One furnish adequate data for determining 5:00 P.M. fire danger for the immediate vicinity of each station. The majority of these stations are located at low elevations with the remainder at lookouts of moderate to high elevation. In between these altitudes is a poorly sampled zone which includes a goodly share of the area of a Forest. The dispatcher often needs to know the status of danger factors and the class of fire danger at any spot intermediate between these high and low elevation stations; perhaps on a hot, dry, south slope; perhaps on a cool, moist, north slope.

Good dispatching also requires a knowledge of the variations of the factors of danger throughout the day and night at any site. If fire danger resulting from all factors is consistently worse, day and night, in one zone than another, more men will be needed for fire control than if relief in the form of lower wind velocities or higher fuel moistures can normally be expected. Consequently, normal differences in fire danger class and in individual danger factors at different hours of the day or night must be known by altitude and aspect if the fire dispatcher is to "calculate the probabilities" most dependably.

To determine how some fire danger factors vary with time of day, with altitude and with aspect, their measurement was started in 1934 by use of continuously recording instruments at the Priest River Experiment Station in northern Idaho. Stations were located in pairs on north and south facing slopes at 2300, 3800, and 5500 feet elevation. Each station is about 100 feet below the top of a ridge which rises from west to east. All instruments are located in natural or small artificial clearings in the Forest. An additional pair of stations is located in the valley bottom at the foot of the ridge. One is in the open, fully exposed to sun and wind, while the other is partially protected by a forest canopy which has been cut to about one half of full forest density.

Although this study has been under way during only two seasons it has already shown that the factors of fire danger differ significantly by hour of day, by altitude, and even by aspects barely separated by a ridgetop. Marked variations have been found in the class of fire danger resulting from the several factors which control fire behavior. The data shown here represent the median, or typical day of August, 1936. August is chosen because the maximum differences between sites occur in this month. Only the salient features can be presented in this paper. More detail will be presented in later articles.

Temperature

Variations in temperature by hour of day and by altitude on south facing slopes for the month of August, 1936, are presented in figure 1-A. The outstanding features of this figure are:

1. The great diurnal change in temperature in the valley bottom and the slight change at high altitudes. Conditions at night are, therefore, favorable for fire control in the valley bottom but less favorable on the mountain top.

2. The presence of an intermediate altitudinal zone which is practically as hot during the day as it is in the valley bottom, but which is warmer at night than either the valley bottom or the higher slopes above.

3. The slight altitudinal difference in temperature by day compared with the great difference at night. This shows that factors of fire danger are generally similar at different altitudes in the day time but become more diverse at night.

Humidity

Variations of relative humidity are shown by figure 1-B, likewise for south slopes. The outstanding features of this chart are:

1. The great diurnal fluctuation in relative humidity on the valley floor and the slight variation on the mountain top, corresponding to the temperature changes in figure 1-A.

2. The presence of an intermediate zone which remains dangerously dry at night. In this zone, for almost 20 hours out of every 24, conditions are more favorable to rapid drying of fuels than on the valley bottom. The altitude of least humidity at night is higher than the altitude of nightly maximum temperature.

3. During fifteen hours out of every 24, relative humidity at the 2300 feet elevation station was greater, hence more favorable to fire control, than it was at any hour at 4400 feet.

North slopes show practically the same differences between altitudes as are shown in figures 1-A and 1-B for south slopes. Air temperatures are very similar at the north and south slope stations, but relative humidity is generally 4 to 6 degrees higher on the northern aspects only 100 feet below the ridge top.

Fuel moisture

Variations in the moisture content of light fuels, which, on a typical August day, depend largely on temperature, humidity, and sunlight, are shown in figures 2-A and 2-B. As would be expected, these data for half-inch wood moisture and for duff moisture show practically the same zones and trends that the temperature and relative humidity charts show. They emphasize the occurrence of the greatest sustained danger in the intermediate altitudinal zone.

The present work has shown, however, that another factor, previously recognized as important by Gast and Stickel 1/, has a decided effect upon duff moisture. This is the heat generated by direct sunlight, at the surface of the duff layer. South facing duff beds receive the rays from the summer sun at an almost perpendicular angle; consequently, they experience a maximum of heating, and, as shown by figure 2-B, south slopes at all altitudes have about the same minimum daily moisture content. Horizontal and north facing duff beds receive the rays at a more oblique angle; consequently, they are heated less and remain one or two percent more moist each day. Half-inch wood cylinders, on the other hand, are all exposed horizontally and 10 inches above the ground; hence, are not subject to this difference in sun's angle on the north and south slopes. Consequently, they have practically the same minimum moisture content on both aspects but respond to temperature and humidity differences with altitude.

Wind

Summer winds in the study area are usually southwesterly; consequently, average wind velocity is stronger on south than on north slopes. Table 1 shows the various wind velocities at the several stations. At the level of 7½ feet above the ground or lower, the maximum velocity usually occurs between noon and 3:00 P.M. while the minimum usually occurs between midnight and 3:00 A.M., regardless of altitude.

Table 1.--Maximum, minimum, and average daily wind velocity at six inflammability stations on the median day of August, 1936. Anemometers 7½ feet above ground.

Wind Velocity	Altitude and Aspect							
	2700'		3800'		5500'		Average	
	North	South	North	South	North	South	North	South
	Miles per hour							
Maximum	1.8	5.1	1.0	5.8	4.5	6.4	2.4	5.8
Minimum	0.7	1.1	0.3	1.1	1.5	3.5	0.8	1.9
Daily	1.0	2.6	0.7	3.0	3.0	4.6	1.6	3.4

As shown by these data, there is a gradual increase in velocity with altitude, but at the height at which the anemometers were exposed, 7½ feet, the increase is not great. Wind movement at the 3800 north slope station does not show this increase, probably because of the greater density of the timber stand surrounding this station.

1/ Gast, P.R., and Stickel, P.W. Solar radiation and relative humidity in relation to duff moisture and forest fire hazard. Mo. Wea. Rev. 57:466-468, illus. 1929.

Fire behavior

Of all the variable factors of fire danger which influence fire behavior in any fuel type, fuel moisture and wind velocity are the two most important. These two factors combine to produce very significant differences in class of fire behavior by time of day, by altitudes, and by aspects. The fire behavior classes, computed by use of the Northern Rocky Mountain fire danger meter are shown in table 2.

Table 2.--Daily march of fire behavior on north and south slopes at elevations of 5500, 3800, and 2700 feet; and on a fully exposed and a partially timbered site at 2300 feet. Median day of August, 1936.

Station	Hour of Day												Ave.
	A.M.						P.M.						
	2	4	6	8	10	Noon	2	4	6	8	10	Mdnt	
	Fire Behavior Classes1/												
2300'													
Partly Timbered	3	3	3	3	3	4	4	4	4	4	4	4	3.6
Fully Exposed	3	3	3	3	4	5	5	4	4	4	4	4	3.8
2700' North	3	3	3	3	3	4	4	4	4	4	3	3	3.4
South	4	4	4	4	4	5	6	6	4	4	4	4	4.5
3800' North	4	4	4	4	4	4	5	4	4	4	4	4	4.1
South	4	4	4	4	5	6	6	6	4	4	4	4	4.6
5500' North	4	4	4	4	4	5	5	5	4	4	4	4	4.2
South	4	4	4	4	5	6	6	6	5	4	4	4	4.7

1/ Computed according to directions on "B" slide of the Northern Rocky Mountain fire danger meter for determining the fire behavior usually associated with each danger class. This procedure eliminates visibility and lightning occurrence which have no bearing on fire behavior.

This table shows concisely certain outstanding facts that the fire dispatcher in Region One can use to improve his estimate of the number of men that should be sent to a fire.

First, the daily pick-up in rate of spread commences between 8:00 and 10:00 A.M. on the south slopes at elevations of perhaps 3500 feet and higher. At lower elevations, and on all north slopes this pick-up commences between 10:00 A.M. and noon. The Forest Service "control by 10:00 A.M." general policy is therefore well selected.

Second, day or night the south slopes at the higher elevations will experience the fastest rates of spread, other things being similar.

Third, there is little difference between north and south aspects at night.

Fourth, the areas experiencing the least danger, due to fuel moisture and wind, are the north facing aspects at low elevations.

Having measured the factors and determined the fire behavior class at an inflammability station, at any hour of the day or night, a dispatcher may refer to table 2 and improve his estimate of the modification that should be made in his rating in order to allow for the effects of altitude and aspect on a typical August day. This table also indicates the allowance that may be made for the shading and wind reduction effects of a partial timber canopy. Furthermore, the dispatcher is able to estimate more accurately the fire behavior to be expected at the fire spot when his men will arrive there, perhaps several hours later, if the weather forecast indicates a normal, typical day.

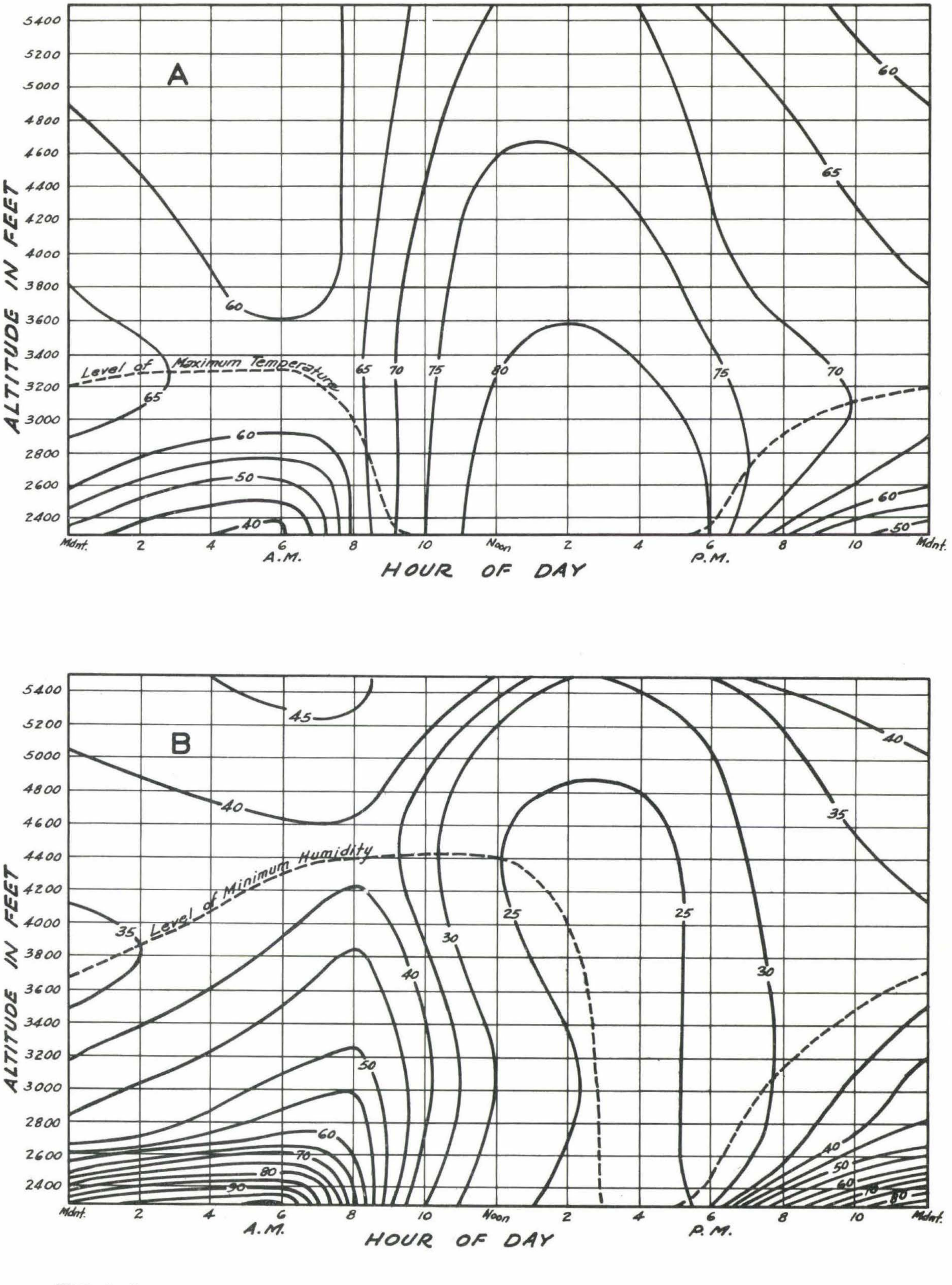

FIG. 1-A-ISOGRAMS OF TEMPERATURE ALONG SOUTH SLOPES
B-ISOGRAMS OF RELATIVE HUMIDITY ALONG SOUTH SLOPES

MEDIAN DAY OF AUGUST, 1936, ON PRIEST RIVER EXPERIMENTAL FOREST

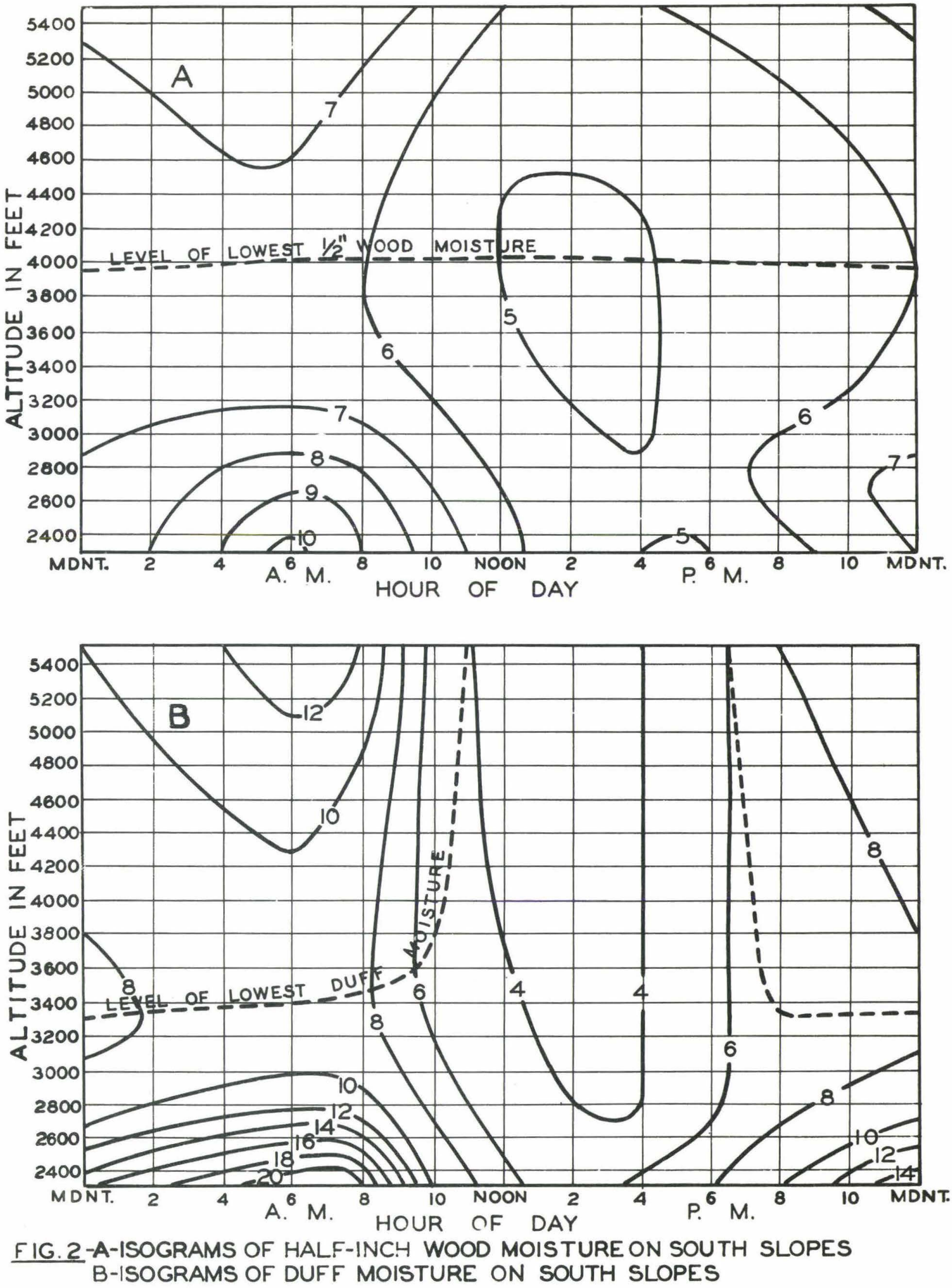

FIG. 2-A-ISOGRAMS OF HALF-INCH WOOD MOISTURE ON SOUTH SLOPES
B-ISOGRAMS OF DUFF MOISTURE ON SOUTH SLOPES

MEDIAN DAY OF AUGUST, 1936, ON PRIEST RIVER EXPERIMENTAL FOREST

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 81 Missoula, Montana May, 1937

SURVIVAL INCREASED BY CAREFULNESS IN FIELD PLANTING

By
Wm. H. Cushman, Region One, Office of Planting, and
R. H. Weidman, Northern Rocky Mountain Forest and
Range Experiment Station

It has long been believed that survival in plantations in the northern Rocky Mountain region could be appreciably increased if regular field planting crews could be made to plant more carefully. Excavation of dead trees after planting has frequently revealed that many of the trees died because they had been planted in shallow holes with their roots doubled up, or because they had been improperly tamped, or because in some other way they had been carelessly set in the ground.

To ascertain the amount of loss due to these causes and to learn whether it could be overcome, trees were carefully planted in the spring of 1936 by members of a field study crew in rows beside check rows of the regular planting crew. The latter rows were simply lines of staked trees running crosswise of the regular crew planting rows. The trees in the carefully planted rows were marked with distinctive stakes. Both regular rows and carefully planted rows were examined in July and October. The first season results are available from 10 series of comparative rows containing 2,600 planted trees, located on the Kaniksu, Coeur d'Alene, and St. Joe National Forests.

Table 1 shows these results in terms of the trees that survived in both types of planting. The careful planting in all cases was done one to two days after the regular planting and under practically the same weather conditions.

All planting was done with 2-0 and 1-2 ponderosa pine planting stock, and the careful planters used stock from the same shipment as that for regular crew planting.

Table 1.--Percent of trees which survived in carefully planted rows as compared with regular crew planted rows

Forest	Locality	Test No.	Survival in July		Survival in October	
			Regular planting	Careful planting	Regular planting	Careful planting
			percent	percent	percent	percent
Kaniksu	Kalispell Bay	1	83	85	80	85
		2	79	95	71	92
		3	89	92	89	86
Coeur d'Alene	Magee R.S.	4	87	89	58	57
	Trail Cr.	5	78	93	55	70
	" "	6	87	91	62	84
	" "	7	79	87	64	72
St. Joe	Collins	8	86	89	80	81
		9	86	93	70	89
		10	81	84	56	70
Weighted average all 10 tests			77	83	66	77

As shown by the table, the average increase in survival at the end of the first season was 11 percent in favor of careful planting. In all the tests in which greater success was obtained, it can logically be attributed to a greater degree of care in planting, but in several cases additional reasons involving special precautions on the part of the careful planters may be indicated.

In the case of test 9, the planting was done on a white fir hazard disposal area on which green trees and snags had been felled and the debris burned broadcast in the spring only a week or two preceding planting. The ground was still matted with live roots and in unburned spots was covered with litter and duff. Under these difficult conditions, many of the trees set by the regular planters frequently were improperly tamped, and thus unable to establish absorption of soil moisture soon enough to prevent death by drying out. A special effort was made in the careful planting to select spots without roots, or to remove the roots, and tamp with soil free of debris. This doubtless accounted for most of the increase of 19 percent in survival.

In the case of test 2, the planting was done when the weather was unusually clear, windy, and of low atmospheric humidity. Under such conditions the instructions to keep the roots wet and exposed to the air as little as possible were doubly important. Here, as elsewhere, the average planter displayed an aversion to carrying excess water in the bottom of the planting bag. He displayed also the usual indifference toward exposure of roots in transferring plants from the heel-in bed to his bag and in handling from the bag to setting in the ground. The careful planters of the study crew, on the other hand, took precautions to observe the instructions to the letter, allowing as little exposure to drying air and wind as consistent with reasonable speed in planting. The resulting increase of 21 percent in survival indicates the very striking advantage in favor of carefulness in this respect and points to real possibilities of improvement in regular crew planting.

Although instructions emphasize the desirability of planting in the shade of natural objects such as stumps, logs, rocks, or movable pieces of debris, the regular crew planters did not take full advantage of the possibilities in this respect. In one row carefully planted by the study crew on a rather severe site, 29 trees planted in the shade gave a survival of 89 percent, whereas 71 trees planted in full sunlight gave a survival of only 58 percent.

In two cases out of ten, the results in table 1 show better survival by the regular crew than by the field study crew. The margin, however, is only 1 to 3 percent and may easily be accounted for by poorer spots available for planting. The study crew had to plant between the rows of the regular planters and obviously had less chance to select the most suitable spots.

The points emphasized in the careful planting were proper tamping without air pockets, roots placed straight down in holes of proper depth, planting free from sod competition and in shade wherever available. Care was also used in exposing roots to the air as little as possible.

The size of the loss--ranging as high as 22 percent and averaging 11 percent--which is found in this investigation as mainly due to careless planting is clearly of enough importance to call for special effort in correcting it. To do so will greatly help in attaining a more acceptable survival and consequent better stocking of plantations in this region.

APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 81 Missoula, Montana August, 1937

PRODUCTION OF LUMBER, LATH, AND SHINGLES IN IDAHO AND MONTANA, 1936 [1]

This is a preliminary statement[2] of production by the lumber, lath and shingle mills of Idaho and Montana, based on returns from the lumber census conducted by the Forest Service in cooperation with the Bureau of the Census. At the time of compilation reports had been received from all Montana and Idaho operators of record. However, all 1936 figures are preliminary and subject to revision in the final report to be published by the Bureau of the Census.

The total lumber cut reported for 1936 by 318 Idaho and Montana mills, each cutting 50 M feet or over during the year, amounted to 1,018,927 M feet, an increase of nearly 21 percent over the combined cut of these two states in 1935. The output of lath increased 20.5 percent from 55,908 M pieces in 1935 to 67,399 M pieces in 1936. In Montana, the production of shingles amounted to 4,170 squares, a gain of 17.1 percent over 1935. For Idaho, shingle production declined from 26,326 squares in 1935 to 17,924 squares in 1936. This decrease, amounting to 31.9 percent is largely accounted for by the loss in northern Idaho of one important shingle mill destroyed by fire in 1936.

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[1] By C. N. Whitney, Special Agent, Bureau of the Census, and Associate Forester, Northern Rocky Mountain Forest and Range Experiment Station.

[2] Released for publication.

Statistics for 1936, with comparative figures for earlier years are given in the following tables:

Table 1. LUMBER CUT BY SPECIES, 1936, M FT. B.M.
(Mills cutting 50 M or over)

Kind of wood	Idaho	Montana	Combined cut	
			Volume	Percent
Idaho white pine	441,848	23,669	465,517	45.7
Ponderosa pine	173,964	130,307	304,271	29.9
Douglas fir	59,547	51,595	111,142	10.9
Western larch	23,787	74,241	98,028	9.6
Spruce	6,102	13,510	19,612	1.9
White fir	12,824	837	13,661	1.4
Cedar	3,119	100	3,219	0.3
Lodgepole pine	1,292	974	2,266	0.2
Hemlock	1,168		1,168	0.1
Cottonwood	43		43	-
Total	723,694	295,233	1,018,927	100.0
Lath, M pieces	53,918	13,481	67,399	
Shingles, squares	17,924	4,170	22,094	

Eighty-six percent of the lumber produced by the commercial mills of Idaho and Montana during 1936 was manufactured by 32 mills, each cutting 5,000 M feet or more. The balance of the cut of 1,018,927 M was reported by 286 mills of smaller capacity with output ranging from 50 M to 5,000 M feet for the year.

In addition to the mills cutting 50 M feet and upward 59 mills in Idaho and 72 Montana mills reported production amounting to less than 50 M each in 1936. The aggregate additional production by these small mills cutting principally to supply lumber needed by the operators for their own use, amounted to 1,233 M for Idaho and 1,633 M for Montana.

Table 2. COMPARATIVE PRODUCTION FOR 1936, 1935 and 1934, LUMBER CUT M FT. B.M.
(Mills cutting less than 50 M feet excluded)

State	1936	1935	1934	Percent of increase	
				1935-1936	1934-1935
Idaho	723,694	609,212	457,089	18.8	33.3
Montana	295,233	233,633	171,841	26.4	36.0
Combined cut	1,018,927	842,845	628,930	20.9	34.0

In 1936 for the first year since 1930, the total lumber cut of Idaho and Montana mills again exceeded a billion board feet. For the ten-year period 1921 to 1930, inclusive, 1921 was the only year in which the combined production of Idaho and Montana amounted to less than a billion feet board measure.

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NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 82 Missoula, Montana February 1938

THE CHARACTER OF THE 1937 FIRE SEASON IN REGION ONE

By

H. T. Gisborne, Sr. Silviculturist

Based on the longest record (May 1 to October 31), the greatest number of stations (89 complete and about 150 partially equipped), and the most accurately made measurements to date in this region, this rating is the fourth consecutive attempt to supply both the Forest Service and all adjacent timber protective interests with a basis for determining the efficiency of fire control on their lands. Naturally, if fire danger is below average, costs and losses should likewise be low. Occasionally in the past, however, danger has been average or even high yet costs and losses have been held low as a result of exceptionally efficient work. Without measurements of the character of the season it was then difficult to prove to Boards of Directors, supervising but absentee officers, and others, that the low costs had been attained in the face of relatively adverse conditions. The function of these annual ratings by the Northern Rocky Mountain Forest and Range Experiment Station is to identify accurately and specifically the character of the past fire season and thereby furnish a base against which to compare costs and losses.

The 1937 season on all of the 10 National Forests in northern Idaho and western Montana rated as average, or between 33% and 66% of worst probable danger. Above 66% is called critical and less than 33% is designated as easy.

The following table shows the percentage of worst probable for each Forest for each of the past four fire seasons using July and August, the peak months, as criteria. Although a longer period, June 11 to September 10 or 20, would be even more indicative, previous measurements do not permit such a comparison.

Table 1.--Percentage of worst probable fire danger

Forest	Year			
	1934	1935	1936	1937
		Percentage		
Bitterroot	59	59	44	61
Cabinet	74	48	70	50
Clearwater	78	52	51	50
Coeur d'Alene	63	48	52	36
Flathead	85	52	69	58
Kaniksu	59	30	56	39
Kootenai	67	44	77	47
Lolo	78	59	77	58
Nezperce	81	70	56	54
St. Joe	63	59	49	43

As shown by these data the Bitterroot, Lolo, and Flathead Forests, a geographical group with the long axis lying in the direction of the prevailing southwesterly winds of this region, experienced high average but not critical fire danger. The Coeur d'Alene and Kaniksu Forests, adjacent to each other in the northwest portion of the region, experienced low average but not a really easy season. The remaining Forests were intermediate between these extremes with the Clearwater and Cabinet rating exactly 50% or truly average in danger.

Compared with the preceding three fire seasons the Bitterroot had its highest danger. All other Forests, however, have had more dangerous seasons in 1934, 1935, or 1936. Of all 10 Forests only the Kaniksu in 1935 has reported less danger than the Coeur d'Alene reported for 1937. Weather Bureau rain maps show that for the period April 1 to August 31, 1937, Stevensville, on the Bitterroot, received only 50% of normal precipitation while Coeur d'Alene City received 168% of its normal.

The May 1 to October 31 records for 1937 show that the fire season opened, with class 4 danger, on nearly all Forests on June 29. It ended with class 3 or lower danger on September 24. The length of season was therefore 86 days, which was 6 days more than in 1936, 14 days less than in 1935, and 2 days less than in 1934.

The 1937 season definitely lacked those usually common periods of several consecutive days of class 6 or higher danger which usually produce a large burned acreage. Not a single Forest reported two or more consecutive days of class 6 danger in 1937 although several ranger districts did experience such danger, including a few days of class 7.

The occurrence of lightning storms was lower than average, the records showing storms on 51 days between June 21 and September 10, whereas the 13-year average is 58 days. One region-wide epidemic of lightning occurred on July 27 and 28, the Forest Service experiencing 270 fires from these storms. A second, but localized, epidemic was experienced on the Flathead Forest on September 17. It is seldom that lightning causes material fire danger so late in the season.

For northern Idaho and western Montana the 1937 fire season therefore takes its place in history as merely average in character of fire danger.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 83 Missoula, Montana February 1938

BRUSHFIELD REFORESTATION IN THE ST. JOE NATIONAL FOREST, IDAHO[1]

C. S. Schopmeyer, Junior Forester

Some of the finest western white pine timber ever logged was taken about 20 years ago from Benewah, Latah, and the western portion of Clearwater Counties of northern Idaho. This area is an extension of the gently rolling hills and deep fertile soil of the famed Palouse wheat country. On extensive portions of this area heavy logging and subsequent burning have been followed by the growth of a dense brush cover composed principally of ceanothus (*Ceanothus sanguinius* Pursh.) and willow (*Salix* sp.). A general view of a typical brushfield is shown in plate 1. On some portions of these areas, particularly on north-facing slopes, seedlings of western white pine and a few other species are now slowly coming up through the brush and will probably form at least a partial stand in the future. In other places, especially on south-facing slopes, seedlings are either absent or are being suppressed because of their inability to compete with the brush. Artificial reforestation of much of this brush-covered area will be necessary to restore its timber productivity.

In a large brushfield area recently acquired by the St. Joe National Forest near Beal's Butte, some experiments were initiated in order to discover practical reforestation methods. Clearing strips through the brush with a bulldozer and broadcast burning has been done in California brushfields preparatory to the establishment of plantations. These treatments have been adapted to this experiment. Although the experiment has not yet produced conclusive results which would indicate the best preparatory treatment, methods used and results to date are presented as a progress report.

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[1] A cooperative project of the Northern Rocky Mountain Forest and Range Experiment Station, the St. Joe National Forest, and the Region One Planting Office.

Within an area of about 9 acres, 3.6 miles (18,810 feet) of parallel strips 8 feet wide and about 12 feet apart were cleared with a bulldozer, a Cletrac 55 with a road builder blade. With this spacing, a bare area of 3.5 acres or about 40 percent of the total area was produced. Stripping was done at the rate of 0.54 miles per day with a gas consumption of 25.6 gallons per day or 112 feet per gallon.

The road builder blade used on the bulldozer removed top soil to a depth varying between 4 and 10 inches in most places. The removal of top soil may seriously decrease the site quality of the strips. The use of a blade with teeth along the lower edge, such as is used in the California Region, might permit stripping without removal of so much top soil.

A fire line with a total length of 1.9 miles (9,900 feet) was cleared with the bulldozer around the perimeter of an 85-acre tract. The brush on this area was burned October 16, 1936. The photographs in plate 1 show how vigorously the brush, especially the willow, grew back during the growing season following burning. An attempt to burn the brush on a portion of the stripped area within the fire line was made, but the fire was not sufficiently intense to kill the brush. In the summer of 1937 this brush did not differ in appearance from unburned brush.

Portions of the strips were planted May 18, 1936 with western white pine (Pinus monticola D. Don.) and ponderosa pine (Pinus ponderosa Lawson). The remainder of the strips, the burnt area and a small area in natural brush were planted May 11-23, 1937. Most of the burnt area was planted with ponderosa pine. Detailed survival counts were made of the seedlings under all of the various conditions on September 22, 1937.

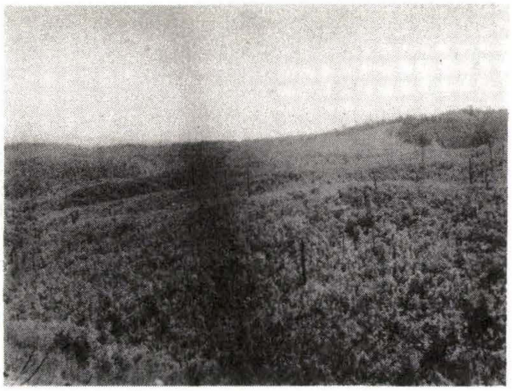
The stock of western white pine planted in 1937 showed practically 100 percent survival after one growing season, both on the burnt area and under the natural brush. On the stripped area survival of seedlings planted in 1937 was appreciably less being only 82 percent. Survival of seedlings planted on the strips in 1936 was about the same as those planted in 1937. Although survival was good in the natural brush, the seedlings do not appear to be as vigorous as those on the burnt area and in the strips. It is doubtful whether many of these seedlings can withstand the root competition of the brush long enough to overtop and kill off the brush.

Survival of seedlings of ponderosa pine planted in the spring of 1937 was not appreciably different after one growing season on the burnt area, the strips, or under natural brush. Survival was approximately 93 percent in all cases. Seedlings planted on the strips in 1936 showed a survival percentage of 72 after two growing seasons.

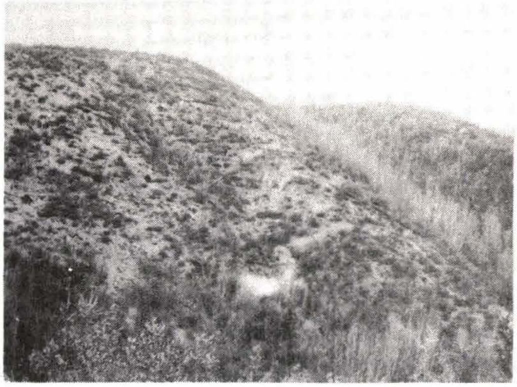
Of importance in the strip plantings is the direction of the strips and the spacing of the seedlings within the strip. On strips running east and west, survival, especially that of western white pine, was better along the south edges of the strips than in either the center rows or the rows along the north edges. The greater amount of shade received by the seedlings in the south rows seems to be significant.

An obstacle to either stripping or burning is the encouragement of Ribes, the alternate host of the white pine blister rust. This weed seems to be held fairly well in check by the dense brush cover, but on the burned and stripped areas a number of new Ribes seedlings have appeared. The extent of an increase in the Ribes population which might be caused by these treatments is not known, but it is a point to be carefully considered in selecting a method of brushfield reforestation.

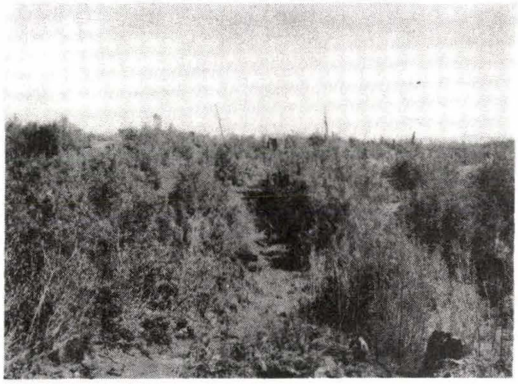
In general the site conditions on these deciduous brushfields do not appear to be as severe as, for example, on the evergreen brushfields of California. If general vigor and survival of seedlings after the first season can be used as an indicator, burning the brush appears to be a satisfactory and economical treatment for preparing these brushfields for planting provided that Ribes can be controlled. The results of future examinations should bring out more definitely the best treatment. Additional studies on the effect of machinery and methods on survival in other areas are necessary to develop a sound brushfield reforestation program.



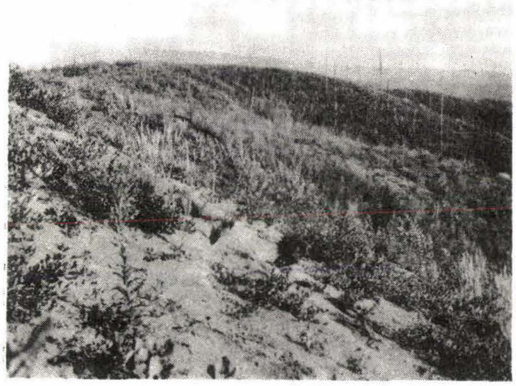
GENERAL VIEW OF BRUSH FIELD



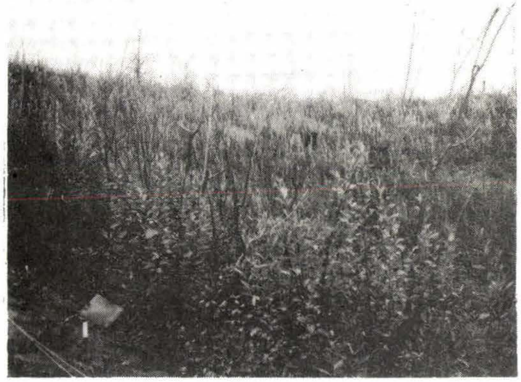
A SOUTH SLOPE ONE YEAR AFTER BURNING SHOWING A SEVERELY BURNT EXPOSED SLOPE AND A MODERATELY BURNT DRAW.



STRIPS CLEARED WITH A BULLDOZER THRU UNBURNT BRUSH.



A SEVERELY BURNT SOUTH SLOPE ONE YEAR AFTER BURNING SHOWING NEW GROWTH OF *CEANOTHUS* BRUSH.



A MODERATELY BURNT DRAW ONE YEAR AFTER BURNING SHOWING NEW GROWTH OF WILLOW BRUSH.

PLATE I. CLEARING METHODS PREPARATORY TO REFORESTATION OF BRUSH FIELDS IN ST. JOE NATIONAL FOREST. IDAHO

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 84 Missoula, Montana April 1938

AN INSTANCE OF INSECT DAMAGE RESULTING FROM ZERO-MARGIN SELECTIVE CUTTING OF PONDEROSA PINE

By James C. Evenden,
U. S. Department of Agriculture
Bureau of Entomology and Plant Quarantine[1]

A sample cutting area for the study of the application of selective logging to ponderosa pine was established near Greenough, Montana by the Northern Rocky Mountain Forest and Range Experiment Station in November 1932. This area, which contained 18.25 acres, was subdivided into three contiguous plots each being cut under a different method of marking. Plot 601 (4.05 acres) was clear cut according to current practice. This procedure resulted in the removal of 94 percent of the total volume of ponderosa pine and 70 percent of the Douglas fir in trees 14 inches d.b.h. and larger. The rather light residual stand was composed of small Douglas fir trees(13 inches d.b.h. and smaller) and a normal quantity of tops and cull logs on the ground.

Plot 602 (6.87 acres) was cut by the zero-margin selection system of marking. Under this method only those logs from trees whose lumber-selling value exceeded their production cost were removed. As in many instances only butt logs were removed, an abnormal quantity of cull logs and large tops resulted.

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[1] Cooperating with the Northern Rocky Mountain Forest and Range Experiment Station of the Forest Service.

Plot 603 (7.33 acres) was cut according to optimum silvicultural practice which left a stand of ponderosa pine amounting to only 60 percent of the volume remaining on the zero-margin (plot 602) area. As there was no economic selection of logs, the volume of residual wood on the ground after logging was materially less than that on the clear-cut plot.

The method of slash disposal was the same for the three areas, the slash being piled and burned. Large tops and logs rejected because of defect and negative value were not treated in the slash-disposal operation.

Description of Trees in Study

Classification of all trees on the zero-margin plot as to vigor, crown, and dominance, as assigned by forest officers at the time of cutting, is shown in table 1.

Table 1.--Classification of ponderosa pine trees on zero-margin plot

		Vigor			Shape of crown 1/			Position of crown 2/			
	Trees	Good	Fair	Poor	P	R	F	D	C	I	S
	No.	Percent			Percent			Percent			
Cut	72	15	49	36	15	50	35	72	24	3	1
Not cut	237	14	52	34	33	41	26	11	36	30	23
Died since cutting	67	9	43	48	28	40	32	8	34	31	27
Alive October 1936	170	15	56	29	36	41	23	12	37	29	22

1/ P - pointed, R - round, F - flat.
2/ D - dominant, C - codominant, I - intermediate, S - suppressed.

It will be noted from the preceding data that the trees selected for cutting did not show any great difference in vigor from the residual stand except that they comprised most of the older and taller individuals, as indicated by the greater number of round and flat tops as well as dominant positions. It will also be seen that the trees living at the time of the 1936 examination were of better vigor than those killed. This same relation is also shown in both crown classification and degree of dominance, as flat-topped and suppressed trees are in most cases less thrifty than those with pointed crowns or in dominant positions. Though the average vitality of the killed trees was undoubtedly less than that of the trees still living at the time of the examination, the cause of death is believed to be directly attributable to insect attack.

Loss From Insect Attack

Examinations to ascertain insect losses were made by the writer in July 1935 and October 1936. The data obtained during the 1935 examination showed that subsequent to the cutting of the timber there had been a light ponderosa pine loss in the residual stand of the silvicultural plot, a very heavy loss on the zero-margin area, and, of course, a negligible loss on the clear-cut plot as only a very light stand of ponderosa pine (6 percent of the total volume) had been left. These were for the most part young trees with a high resistance to insect attack.

The economic marking on the zero-margin plot left 246 ponderosa pines above 6 inches d.b.h. Since 7 of these were broken by logging and 2 harbored primary attacks of bark beetles at the time of marking, the actual residual stand was 237 trees. The loss prior to July 1935 amounted to 27 percent of the total number, or 64 trees. As the dead trees were somewhat smaller than most of the trees in the residual stand, this loss represented approximately 20 percent of the total volume. The examination in October 1936 added 3 more dead or dying trees to the loss on the zero-margin plot, which increased the total to 28 percent, or 67 trees.

Of the dead trees 4 had been killed by primary attacks of Dendroctonus brevicomis Lec., 1 by D. monticolae Hopk., and the remainder by attacks of Ips. oregoni (Eich.) and I. emarginatus (Lec.) in the tops, accompanied by a sour-sap condition below the point of attack. A sour or fermented sap in the lower bole is caused by an excess of moisture associated with a cessation of transpiration due to destruction of foliage. This condition often follows severe defoliation by insects or, as in this case, top killing by beetles which included the entire crown. A few of the dead trees had light attacks of the red turpentine beetle, D. valens Lec., which may have made them more susceptible to attacks of secondary beetles. In the sour-sap portion of the boles there were scattered attacks of Hylurgops rugipennis (Mann.), which were purely secondary.

Abundant Host Material Causes Insect Attack

The most logical reason for the heavy loss in the residual stand of the zero-margin area, as compared with the loss in the surrounding general region, is the susceptibility of the trees to insect attack and the attraction of secondary beetles to the heavy accumulation of large tops and cull and other logs of negative value due to the economic selection of logs. This is not an unusual condition as ponderosa pine slash under certain conditions is a potential source of danger to adjacent trees. A broken tree top or a windfall is often the medium through which a number of trees are subsequently killed by secondary bark beetles. The severity of such damage often depends on the quantity of fresh slash as well as the conditions under which it is formed. There are several species of Ips beetles which are attracted to and breed in material of this character and which upon emergence, if additional slash and logging debris are not available, will attack and kill young trees or the tops of larger ones. At times these beetles are attracted to a locality by freshly cut slash, but attack adjacent standing trees.

During the early part of the 1933 season the rejected logs and large tops on the zero-margin plot were attacked by Ips beetles, and a large percentage of the trees that died subsequently were top-killed by these insects in the fall of that year. A number of the top-killed trees were reattacked the following season. The second attack was confined to the upper part of the bole below the top-killed portion, and this in most cases completed the destruction of the crown. There were 6 top-killing attacks in 1934 and 2 in 1935. Though the evidence of this series of attacks still remained at the time of the examination, no attempt is made in this paper to establish an interrelationship of the different broods, though naturally its existence is assumed.

Conclusions

Infestations by so-called secondary bark beetles are in most cases short-lived and usually follow sporadic wood cuttings or logging operations. The position of the writer relative to the danger of ponderosa pine slash as a medium through which destructive outbreaks of bark beetles may develop is based upon present methods of operation and not upon conditions associated with a zero-margin or economic selection of logs. An annual accumulation of large tops and cull logs, comparable to conditions on the zero-margin plot, creates a situation with which the workers of the forest insect laboratory at Coeur d'Alene, Idaho have had no experience. Such methods of cutting are a marked departure from former practices, and the entomological danger of such steps should be recognized.

Though the loss of trees on this small area illustrates what happened in one instance, experience will not permit the acceptance of such a few data as a predication of the damage that will be associated with an intensive application of zero-margin selective logging. It is true that the results of this small experiment are not conducive to the adoption of this type of cutting as a large percentage of the expected second cut has already been destroyed. However, if there is merit in this method it should not be discarded for entomological reasons until a thorough study has demonstrated the degree of danger as well as the impossibility of modifying its application to avoid the present criticism.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 85 Missoula, Montana May 1938

THE NORTHERN ROCKY MOUNTAIN FIRE DANGER METER,

MODEL NO. 5

By H. T. Gisborne, In Charge, Division Forest Protection

In 1931 the Northern Rocky Mountain Forest and Range Experiment Station first proposed the integration of fire danger factors into a numerical scale of danger by use of a device called a fire danger meter. After four years of field tests and development, on 10 National Forests in Region One, model no. 4 was designed and judged satisfactory for official use in standardizing the classification of fire danger and as a basis for determining the size of the fire control organization needed to meet current fire danger.

Model no. 4 was used without change during the three-year period 1935 to 1937, inclusive. Meanwhile a file record was accumulated showing specific cases of both desirable and possible refinements. One desired change, the incorporation of vegetative condition such as the greenness and luxuriance of grasses, weeds, and shrubs, was studied intensively during this period but even yet no sufficiently accurate method has been found to warrant substitution for calendar date. It is believed that in some seasons this low vegetation, which is present in material quantities in the more open forest types, matures earlier than usual or stays green longer than usual and thereby accelerates fire sooner or retards it later than indicated by the calendar date index of this phenological process. This is the exceptional rather than the normal case, however, and on fully timbered areas the condition of vegetation is entirely immaterial because on such sites this type of fuel is so sparse, or entirely lacking, that it is not at all a factor in rate of spread of fire. As the other factors of danger are being quite accurately measured the danger rating scheme would be materially weakened by incorporating an index which could not be similarly measured. This desired refinement, therefore, must wait upon further research.

The file record for 1935 to 1937 disclosed, however, certain other modifications of the model 4 meter which were both desirable and possible. This record showed that two of the 112 danger ratings carried on slide B were definitely out of line with adjacent ratings and that one other was clearly open to question. The 112 ratings were therefore plotted graphically, by columns and lines, in an attempt to smooth out these three known and other suspected irregularities. This had been tried before but without success so long as danger was expressed in only seven classes.

The new smoothing was aided by Regional Office and National Forest recognition of the fact that whereas seven classes of danger had seemed, in 1931 and 1932, to be extreme refinement, continued use had disclosed that further refinement was not only possible but decidedly practicable. Field men had learned, in this three-year period, that there is a real difference in fire behavior and in manpower needs between a low class 4 and a high class 4, for example. Such a statement would have been ridiculed in 1932, when even seven classes of danger were characterized as "hair splitting." By 1937, however, old-time rangers were reporting "low class 5, middle class 5, and high class 5 danger" and they were manning more lookout and guard stations for high 5 than for low 5 danger. Obviously, they were ready for danger measured by tenths of classes.

When the 112 ratings, in seven classes, carried by slide B, were graded smoothly by tenths of classes and plotted graphically, the three known irregularities became clearly evident. Others, previously unsuspected, also became apparent although only nine other cases, out of the 112, warranted changing to a different whole class of danger. This smoothing and correcting process therefore resulted in changing only 12 of the 112 previous ratings. The changes in all cases were to lower danger, which was to be expected, because the original ratings had been made, intentionally, to over-rate rather than underrate whenever there was any doubt concerning the effect of a particular combination of factors.

The new model 5 meter consequently gives somewhat lower ratings of danger than were given by model 4. The new ratings are, however, very definitely more consistent for all possible combinations of factors, and more accurate throughout the entire scale. They are also more conservative, and, happily, more economical of fire control funds. In fact, one entirely unforeseen result of this research will be a saving of fire control funds more than sufficient to pay for all the costs of measuring fire danger. The 1937 records for two Forests, on which the new meter was recently tested, show, for example, that by the new ratings 310 man-days of lookout or smokechaser labor would have been saved on one

Forest and 558 man-days on the other. While the former is only 4.7% and the latter is 7.3% of the total July-August fire control labor warranted by the old meter, the reduced cost far more than offsets all the time given on either Forest to fire danger measurement.

The new, smoothed ratings consequently refine the definition of danger to the nearest tenth of a class and at the same time, by improved accuracy, "pay for their cost" perhaps several times over. If 100 of the original 112 ratings were such as to give adequate protection, the lowering of 12 cases should not in the least contribute to underrating danger and over-exposing the Forests to damage. As three years of trial produced no evidence of general underrating the new meter is believed to be entirely safe even though materially more economical.

The second major refinement in the model 5 meter consists of a changed scale of visibility distance for the western Montana and North Idaho Forests, and the addition of a new scale for the central and eastern Montana Forests. These alterations result in economy on the eastern Forests and improved efficiency on the western. In a few cases, on the western Forests, the new scale results in raising the danger rating when visibility is between 1.1 and 3.9 miles, but these are considered in the statement of economy previously made.

A third change consists of the removal of the former specifications as to manning the fire control organization commensurate with each class of danger, and the substitution of a mere reference to the fire control plans for such detail. The former specifications served admirably to illustrate the fact that danger is measured only to indicate what should be done about it, and that danger measurement is but the first step in efficient fire control. No compact device like a danger meter could hope, however, to contain the detailed statements of organization action warranted by each class or fraction of a class of danger. The model 5 meter therefore refers the user to the detailed plans.

Other minor refinements include more exact specification of the limits of each group of fuel moistures and wind velocities, a new tabulation of rate of spread of fire by fire danger class and by fuel type classes, and a new special provision to prevent low visibility due to fog alone from raising the danger rating.

Copies of the new model 5 meter are available, without charge, to all forest protective agencies, forest school faculties, and other cooperators. This meter should not be used, however, in other regions of timber type, fuel type, climate, and weather different from those of the Northern Rocky Mountains. Other Forest Experiment Stations have produced or are evolving meters, danger boards, or other similar devices employing factors and integrations specifically suited to local conditions in other regions.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 86 Missoula, Montana July 1938

PRODUCTION OF LUMBER AND TIMBER PRODUCTS IN IDAHO AND MONTANA, 1937. [1]

The production statistics presented in this preliminary summary of returns from Idaho and Montana manufacturers were collected at the census of lumber and timber products for 1937 conducted by the Forest Service in cooperation with the Bureau of the Census. At the time of compilation all operators of record in Montana and northern Idaho had reported. Late returns from two small mills in southern Idaho may change the indicated State of Idaho total cut figures slightly. All 1937 figures contained in this statement [2] are preliminary and subject to possible corrections in the final report to be published by the Bureau of the Census.

Since 1932, when the total cut by Idaho and Montana mills was the lowest reported in more than a quarter of a century, production in both states has increased annually. For 1937 the total lumber cut in these two states, reported by 348 mills each cutting 50 M feet or over, amounted to 1,131,901 M feet, an increase of 11.1 percent over the Idaho and Montana cut in 1936. The Montana output of 334,950 M feet by 144 mills in 1937 is the largest cut recorded for that State since 1929. In Idaho a cut of 796,951 M feet by 204 mills is larger than that of any other year since 1930.

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[1] By C. N. Whitney, Special Agent, Bureau of the Census, and Associate Forester, Northern Rocky Mountain Forest and Range Experiment Station.

[2] Released for publication.

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Detailed lumber-production statistics by kinds of wood for Montana and Idaho are given in table 1, comparative cut figures for the past three years in table 2, and lumber stocks on hand at the beginning and end of the year in table 3. A summary showing production of the principal round, hewed, and split products in 1937 is given in table 4.

Table 1.--Lumber cut by species, 1937, M feet BM
(Mills cutting 50 M or over)

Kind of wood	Idaho	Montana	Combined cut	
			Volume	Percent
Idaho white pine	459,531	20,186	479,717	42.4
Ponderosa pine	213,557	154,659	368,216	32.5
Douglas fir	64,728	57,874	122,602	10.8
Western larch	29,311	84,686	113,997	10.1
Spruce	4,749	14,772	19,521	1.7
White fir	16,725	1,332	18,057	1.6
Cedar	5,087	100	5,187	0.4
Lodgepole pine	1,654	1,334	2,988	0.3
Hemlock	911	-	911	0.1
Cottonwood	698	7	705	0.1
Total	796,951	334,950	1,131,901	100.0
Lath, M pieces	60,737	17,249	77,986	
Shingles, squares	32,053	1,670	33,723	

In addition to the 348 mills cutting 50 M feet and upward, 67 mills in Idaho and 74 Montana mills reported production amounting to less than 50 M each in 1937. The aggregate additional production reported by these very small mills, not covered by cut figures included in table 1, amounted to 1,294 M for Idaho and 1,452 M for Montana.

Approximately 75 percent of the aggregate lumber cut of Idaho and Montana in 1937 by mills cutting 50 M feet or more was contributed by Idaho white pine and ponderosa pine. For each year since 1929 these two leading species have contributed from 71 to 78 percent of the total volume of all species reported. In each of the years 1927, 1928, and 1929 the combined cut of Idaho white pine and ponderosa pine amounted to approximately 64 percent of the total volume reported. In 1931 and again in 1933 Idaho white pine, alone, contributed about 51 percent of the total output for the two states. The 1937 cut of this species in Idaho, amounting to 459,531 M feet, was the largest annual cut of white pine ever reported for the state. The second highest annual cut of white pine in Idaho was that reported for the year 1936 with a total output of 441,848 M feet.

Table 2.--Comparative production for 1937, 1936, and 1935, lumber cut M feet BM
(Mills cutting less than 50 M feet excluded)

State	1937	1936	1935	Percent of increase	
				1936-1937	1935-1936
Idaho	796,951	723,804	609,212	10.1	18.8
Montana	334,950	295,233	233,633	13.4	26.4
Combined cut	1,131,901	1,019,037	842,845	11.1	20.9

In comparison with the average annual cut in Montana and Idaho for the five-year period 1924 to 1928, inclusive, which is considered a period of normal production in this region, the extent of the recovery indicated by the results of the 1937 census would be 88 percent for Montana and approximately 80 percent in Idaho. From 1924 to 1928 the five-year average annual cut amounted to 380,406 M feet in Montana and 1,001,492 M feet in Idaho. In 1932 the Montana cut was only 111,048 M and the Idaho cut 248,378 M feet.

During 1937 the total lumber stocks in Idaho and Montana increased from 527,707 M BM at the beginning of the year to 590,947 M BM on December 31. The following summary includes inventories reported by all mills cutting 50 M feet and upwards.

Table 3.--Summary of lumber stocks

State	Lumber on hand--M feet BM		Percent of increase
	January 1, 1937	December 31, 1937	
Idaho	399,728	453,219	13.4
Montana	127,979	137,728	7.6
Total	527,707	590,947	12.0

Summarized production figures for poles and piling, posts, hewed ties, and mine timbers are given in the following table. Considerable quantities of pulpwood and cordwood reported for each state are not included in this preliminary statement.

Table 4.--Production of principal round, hewed, and split products--1937

State	Poles and piling (Linear feet)	Posts (No.pieces)	Hewed ties (No.pieces)	Mine timbers (Linear feet)
Idaho	12,884,277	160,630	3,949	1,449,600
Montana	1,082,325	231,040	2,009	8,801,445
Total	13,966,602	391,670	5,958	10,251,045

Very large gains in the total output of nearly all classes of miscellaneous timber products were made in 1937 as compared with 1935, the latest preceding census at which statistics for such products were collected.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 87 Missoula, Montana November 1938

THE CHARACTER OF THE 1938 FIRE SEASON IN REGION ONE

By

H. T. Gisborne, Sr. Silviculturist

On the basis of the daily measurements of fire danger on the 17 National Forests in the northern Rocky Mountain region the 1938 fire season was both shorter in duration and of lower danger than has been common during the past few years.

Although an exceptional June drought in extreme northern Idaho and northwestern Montana threatened early and high fire danger, good rains the first week of July relieved this situation. By July 10 to 13, nevertheless, practically all Forests were experiencing class 4 danger which warrants the placing of the regular summer protective organization. From then until the sustained occurrence of class 3, or lower danger, on September 21, gave a fire season length of 73 days. Comparable figures for previous years are: 1937 - 86 days; 1936 - 80 days; 1935 - 100 days; and 1934 - 88 days.

July and August, the months of usually highest danger in this region, were average or below, this year. Only the Cabinet, Coeur d'Alene, Kaniksu, and Kootenai Forests rated about 50% of worst probable danger. No Forests rated critical - 66% or more, 15 rated average - 33% to 66%, and 2, in south-central Montana rated easy, or below 33%. The ratings for the western Montana and North Idaho Forests are shown by table 1, together with comparable data for the preceding four seasons.

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Table 1.--Percentage of worst probable fire danger

Forest	Year				
	1934	1935	1936	1937	1938
			Percentage		
Bitterroot	59	59	44	61	38
Cabinet	74	48	70	50	52
Clearwater	78	52	51	50	39
Coeur d'Alene	63	48	52	36	49
Flathead	85	52	69	58	47
Kaniksu	59	30	56	39	49
Kootenai	67	44	77	47	51
Lolo	78	59	77	58	43
Nezperce	81	70	56	54	36
St. Joe	63	59	49	43	41

A marked deficiency in rainfall from April 1 to August 31, localized in the Clarks Fork drainage and most acute in its lower end, was the principal factor causing moderately high danger in these sections. Even within this area, however, good rains occurred sporadically on small subdivisions, sometimes reaching almost cloudburst proportions. Short, heavy rains often are of less benefit, however, than protracted drizzles of lesser amount because the former occur too rapidly to be absorbed by snags, windfalls, and other heavy fuels.

Lightning was the second most important factor of danger in 1938 and was a universal and almost continuous threat on all the Forests of the entire Region from early June until the end of September. On the western Montana and northern Idaho Forests there are normally lightning storms on 58 of the 83 days between June 20 and September 11. This year there were storms on 65 days of this period. The near-record number of 100 lightning fires started the night of July 15 on the Kaniksu Forest is evidence of the activity of these storms. The prompt control of all these fires by the Kaniksu organization, with six ranger districts rating class 4.6 to 4.9 in danger on the day of control, is evidence of the dividends now being collected from recent investments in better fire control planning, better facilities, and better training of men. A similar epidemic of some 150 fires in 1926 resulted in the burning of more than 60,000 acres under danger conditions which, although not measured at that time, are not believed to have been any worse than this year.

A second regional epidemic of 182 lightning fires during the first ten days of September, which normally brings only 45 fires from this cause, also was handled successfully by the fire control organization.

While the 1938 season was like that of 1937 in lacking those dangerous periods of several consecutive days of class 6 or higher danger, it was even safer because during mid-August, when danger is usually greatest, sporadic but protracted rains produced a marked reduction in danger. This was followed, however, by a return to normal danger and then by the most dangerous September on record.

During the first few days of September, and again between the 14th and 23rd, many Weather Bureau stations reported all-time, record-breaking temperatures of over 90 degrees F. Mean temperatures for the month ran as much as 9.6 degrees above normal. Some Forests, and many ranger districts, experienced the highest fire danger of the year during this distinctly abnormal September.

Under such erratic fluctuations of danger the 1938 season, even though it is rated as slightly below normal in average fire danger, was clearly not one which safely permitted marked retrenchment in fire control presuppression expense, especially in northern Idaho and northwestern Montana.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 88 Missoula, Montana November 1938

TAKING THE GUESS OUT OF CEDAR POLE INVENTORIES

Foreword

For years northern Idaho has been recognized as one of the leading cedar pole producing areas in the United States. With a current average production of 400 M poles, the annual revenue now aggregates about $1,500,000 and the industry provides employment to several thousand men each year.

In planning for the future any business man will agree that one of the first essentials is a reliable inventory of his available resources. As an aid to the lumberman in obtaining a detailed inventory of his cedar pole stands, the Forest Service has been endeavoring to work out a dependable method of determining the true height of cedar poles as well as the actual number. In doing so they have worked along lines comparable to those employed in cruising other tree species.

Such a system has finally been worked out by James W. Girard, Assistant Director of National Forest Survey, with the Growth Phase crew of the Forest Survey[1] carrying out most of the field investigations. A discussion of this system is presented in the following pages.

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[1] L. J. Cummings, Richard M. Varney, and Robert E. Swanson.

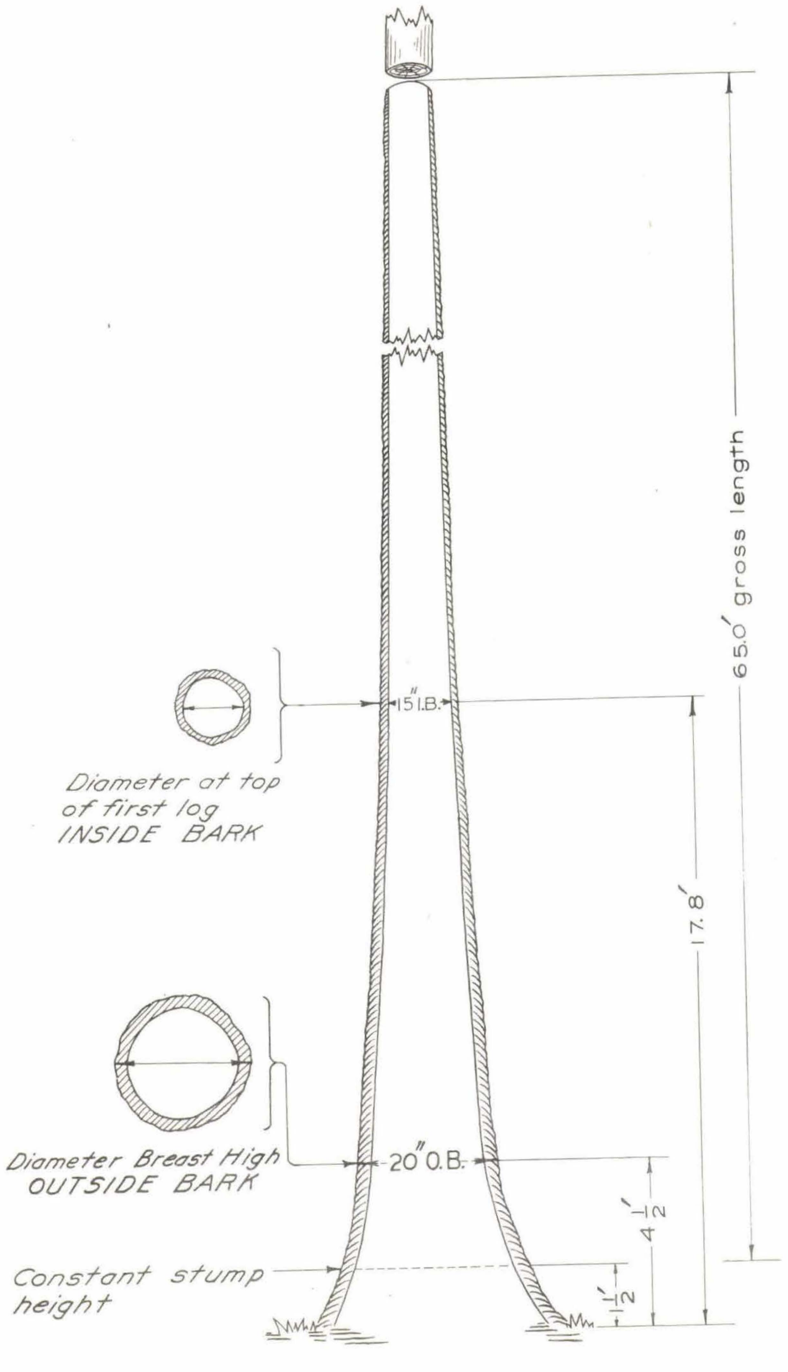

65.0' gross length
15" I.B.
Diameter at top of first log INSIDE BARK
17.8'
Diameter Breast High OUTSIDE BARK
20" O.B.
$4\frac{1}{2}'$
Constant stump height
$1\frac{1}{2}'$

DIAGRAM EXPLAINING METHOD OF MEASURING GIRARD FORM CLASS

TO MEASURE FORM CLASS

(1) Measure diameter breast high outside bark

(2) Measure diameter inside bark at top of first log (16.3 ft.) above constant stump height of $1\frac{1}{2}$ feet.

(3) Divide D.I.B. at top of first log by D.B.H. outside bark to get form class.

EXAMPLE

20.0 = D.B.H. Outside bark
15.0 = D.I.B. Top first log
$\frac{15}{20}$ = FORM CLASS 75

General Discussion

Form class taper curves for cedar poles were devised in 1937 by James W. Girard, as a practical means whereby timber cruisers, even though inexperienced, can accurately estimate gross lengths of cedar poles. These curves have recently been used by cruisers of the Forest Survey in Region One in connection with a cedar increment study covering northern Idaho and northeastern Washington. In view of checks carried on in conjunction with the study which show that the curves give remarkably good estimates, this note dealing with the results obtained and technic worked out by the growth crew in using them is submitted.

The Girard form class is the ratio of the diameter inside bark at the top of the first 16-foot log to the diameter outside bark at breast high, expressed as a percent (see diagram). It is simply a measure of the amount of taper in the butt log in terms of the breast high diameter. Thus a tree with a form class of 75 has a butt log with a top diameter inside bark which is 75 percent of the outside bark measurement at breast height. A tree with more taper will have a smaller form class, while one with less taper will have a correspondingly higher form class.

This ratio, together with knowledge of the average taper characteristic in trees of given form classes, is the basis of form class curves. For example, trees of form class 75 have an average rate of taper which is expressed in the form class 75 curve on the attached graph. This method of cruising consists, then, of merely taking advantage of the fact that the size and form class will, on the average, indicate the length of the remainder of the bole.

Use of Curves

The data necessary to use the curves are the d.b.h. measurement and the estimated form class of the tree under consideration. The length of the pole is then read directly from the curves (see directions on attached graph). Deduction for rot, sweep, and other defect must be made from the gross length thus obtained. Since the success of the method depends largely upon a reasonably accurate estimation of form class, this is the most important and exacting part of the procedure. It has been our experience, however, that the ability to estimate form class sufficiently well is neither a difficult task to acquire, nor once attained is it hard to keep.

Two methods were used in developing this ability. The first consisted of visiting pole cutting operations to estimate the form class of trees about to be felled and to check these estimates on the down trees. The second and most practical method required the use of linesmen's climbers and belt and some means of determining bark thickness. Estimated form class of standing trees was checked by climbing to the top of the first 16-foot log length to measure diameter and bark thickness. The fact that it is independent of cutting operations and that it may be used on the specific areas makes climbing the preferred method.

Little training is necessary to develop the cruiser to a point where he can recognize form class. Members of the growth crew, entirely unfamiliar with form class, were able to consistently approximate the actual form class of sample trees after only a few measurements. If the cruiser will spend part of a day estimating and checking, then measure as few as two or three sample trees each day during the cruise, he will soon attain the proficiency needed for good use of the curves.

The fact that the range of form classes encountered in the field is small for a majority of the trees operates to make the estimation of form class easy. Ninety-two percent of nearly 400 trees measured fell within the 70 to 85 form class group, the average of all samples being 77. Within this range it is assumed that errors will be small and compensating. However, should the estimator miss the actual form class by as much as five points, examination of the curves will show that this will result in no serious error.

It should be pointed out that in cases of abnormal butt swell allowance should be made by taking the diameter measurement above the swell. In such cases, the top measurement should be taken at the regular height (17.8 feet above ground). The estimator should also pay particular attention to the matter of bark thickness at the 17.8-foot point until his experience enables him to recognize thick and thin bark, and the approximate allowances to make.

Results Obtained by the Use of Curves

Aside from the checks of form class estimation described above, two checks of the accuracy of the curves were carried on during the cedar growth study. One consisted of measuring with chain and Abney level the pole length of a sufficient number of trees on each cruise strip so that a comparison with estimates taken from the form class graph was constantly available for each localized area. The other check was based on actual measurements of form class and gross pole length of trees, particularly those cut on various widely scattered pole-making operations, as well as some windfalls.

Samples from 9 drainages in the Kaniksu and 13 in the St. Joe and Clearwater areas were included in the latter check. Approximately 20 sample trees were measured in all but 4 drainages. Trees were taken at random from various elevations and aspects in an effort to eliminate personal bias from the selection of samples and to get a representative variation of growing conditions. Measurements taken for 374 poles show:

Estimated total linear feet using Girard's form class taper curves	= 20,258
Actual total linear feet	= 19,987
Difference	271

The difference represents an over-estimate of 1.4 percent given by the curves, or an average linear difference of +.72 feet per pole.

An analysis of the samples taken from pole-making operations where 20 or more measurements were made presents an interesting picture of the variation encountered.

Pole-making operation	Number of samples measured	Linear feet of pole		Average error per pole in feet	Percent error
		Total actual	Total estimated from curves		
No. 1	60	3260.0	3236.5	-0.39	-0.72
No. 2	60	3129.0	3166.0	+0.62	+1.18
No. 3	39	2249.5	2235.5	-0.36	-0.62
No. 4	37	2118.0	2099.0	-0.51	-0.90
No. 5	20	1145.0	1110.0	-1.75	-3.06
No. 6	20	954.0	1010.5	+2.83	+5.92
No. 7	19	1077.0	1139.0	+3.26	+5.76
No. 8	20	1003.0	1067.0	+3.20	+6.38
No. 9	20	973.5	1020.0	+2.33	+4.78
No. 10	23	1348.5	1354.0	+0.24	+0.41

Whether coincidental or not, it is interesting to note the small errors of estimate for operations Nos. 1, 2, 3, and 4 on which from 37 to 60 measurements were taken in an effort to get a representative sample of the drainage as to slope, aspect, elevation, and other site conditions.

Practical Suggestions

A few suggestions which may aid in the use of the curves:

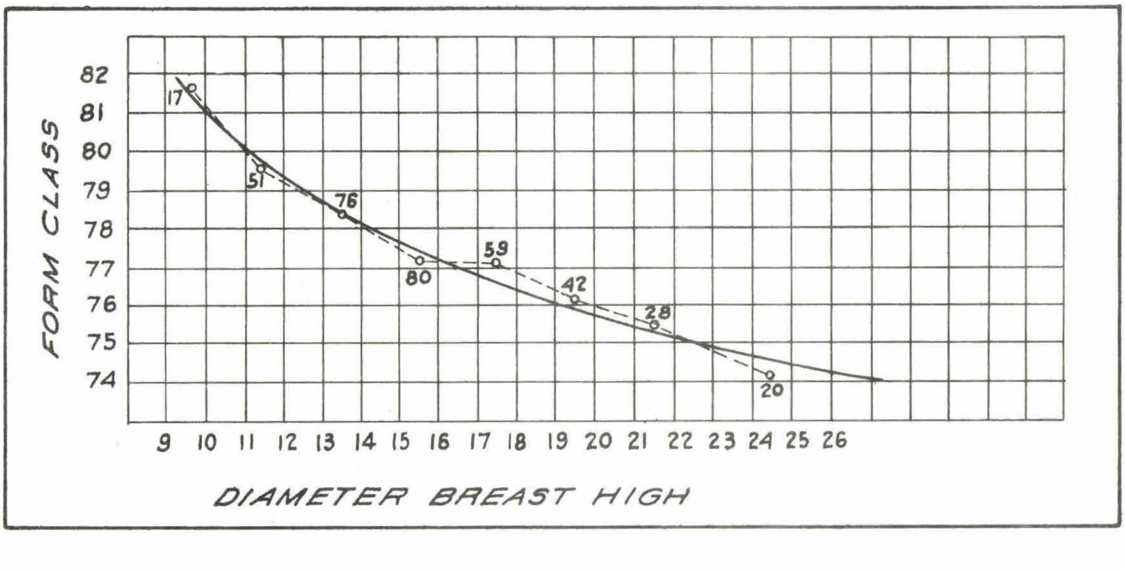
1. The fact that the estimated length obtained from the curves is the gross figure from which necessary deductions for defect are taken must be kept well in mind.

2. It is desirable to employ an Abney check of estimated pole lengths so that adjustment may be made for local variation. Where possible, however, measurement of cut trees or windfalls is better. An occasional check by these means will enable the cruiser to add or subtract the 5- or 10-foot length necessary to allow for individual differences.

3. Form class for a localized area is usually consistent, but varies considerably from hilltop to stream bottom, the higher form classes occurring more often in the bottoms.

4. In even-aged stands, which occupy by far the greater part of commercially important cedar-pole areas, the smaller trees have higher form classes than the larger, more buttressed trees. This statement is borne out by graph 2 which is based on all samples measured in this study.

Graph 2. - Relationship of form class to d.b.h. in even-aged cedar pole stands



Conclusion

In view of the results obtained from the checks made in connection with the cedar pole growth study, Girard's form class taper curves are recommended as a highly useful aid in the cruising of cedar poles in Region One.

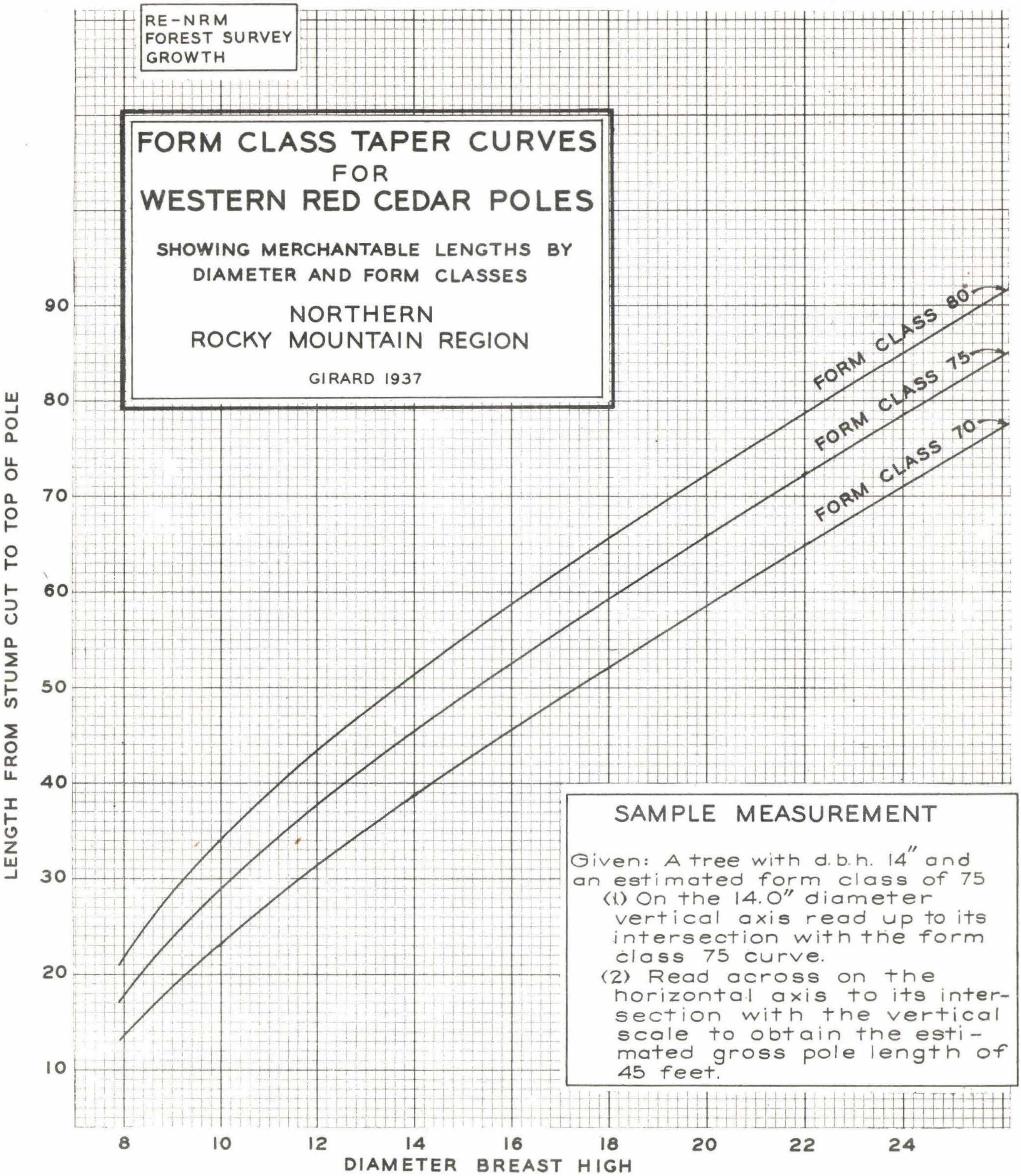
RE-NRM
FOREST SURVEY
GROWTH

FORM CLASS TAPER CURVES
FOR
WESTERN RED CEDAR POLES

SHOWING MERCHANTABLE LENGTHS BY
DIAMETER AND FORM CLASSES

NORTHERN
ROCKY MOUNTAIN REGION

GIRARD 1937



SAMPLE MEASUREMENT

Given: A tree with d.b.h. 14" and an estimated form class of 75
(1) On the 14.0" diameter vertical axis read up to its intersection with the form class 75 curve.
(2) Read across on the horizontal axis to its intersection with the vertical scale to obtain the estimated gross pole length of 45 feet.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 89 Missoula, Montana January 1939

DOWNY BROME (CHEATGRASS) RANGE FOR HORSES

By
Leon C. Hurtt, Senior Range Examiner

Downy brome or cheatgrass, Bromus tectorum, was apparently introduced to the United States from overseas sixty or more years ago and reached western Montana in its aggressive invasion somewhere around the turn of the century. It found nearly ideal conditions for spreading with the abandonment of great areas of dry-farmed lands immediately after the World War. It is dominant in early stages of succession on many thousand acres of dry-farmed and on overgrazed ranges in western Montana and other states. Cheatgrass is the name more commonly used locally.

Some contend that cheatgrass is a serious menace to range productivity while many stockmen hold it in high regard, especially for spring feed and again in the fall after green growth starts. A test conducted by the Forest Service in 1937 and 1938 provides some preliminary data as to the value of cheatgrass range for horses. In May 1937, an area of 30.5 acres of once dry-farmed land in the foothills of the Flathead Valley, about 65 miles northwest of Missoula, was fenced for this test. This land has not been tilled for a period of ten or more years. Based on 96 clipped and air-dried samples in 1937, cheatgrass made up 89 percent by weight of total vegetation, while salsify, yarrow, mountain dandelion, mustard, and other weeds made up 10 percent and other grasses, mainly Sandberg bluegrass, less than one percent of the total volume of forage.

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In 1937 three idle saddle horses, 6 to 11 years old, were weighed and placed in this 30.5-acre pasture on May 25 with access to a natural spring and removed on December 1. In 1938 four horses were grazed on this same pasture from June 2 to October 20, and two of these remained until November 19. In 1937 the horses were weighed at intervals of two weeks and in 1938 at intervals of approximately three weeks. Following are average weights of the horses through two seasons:

Average weight of idle saddle horses on cheatgrass range.

Three horses - 1937		Four horses - 1938	
	Pounds		Pounds
May 25	1133	June 2	1212½
June 8	1217	June 23	1232½
June 22	1233	July 14	1231½
July 6	1235	August 4	1207½
July 20	1233	September 1	1220
August 3	1233	September 22	1175
August 17	1212	October 20	1142½
August 31	1220	November 19 (two horses only)	1010
September 14	1198		
September 29	1182		
October 14	1100		
November 1	1120		
December 1	1080		
Average net loss 6-1/5 mos.	53#	Average net loss 4-2/3 mos.	70#
		Average net loss for 2 horses carried 5-2/3 mos.	90#
Total feed furnished, 18.6 horse months.		Total feed furnished, 20.4 horse months.	

It will be noted that near peak weights during both 1937 and 1938 were well maintained into September for more than two months after the cheatgrass matured and became harsh and dry. In late October 1937, slight gains in weights took place, coincident with fall growth of cheatgrass resulting from early fall rains. In 1938, fall rains were insufficient to produce any material amount of green fall growth before horses were removed. Horses were lively and in especially good condition at the close of the 1937 season and slightly less so at the close in 1938. The average loss of weight was 53 pounds the first season and 70 pounds the second from the initial weights. The two horses that remained in the pasture in 1938 until November 19 averaged 90 pounds lighter than when the test started in the spring.

On December 1, 1937, there still remained enough matured cheatgrass to carry the three horses for several weeks but by November 19, 1938, the utilization was much closer. More than half the cheatgrass heads were filled with smut in 1937. In spite of this, the horses were alert and thrifty in appearance throughout the late summer after all palatable weeds had been eaten when they were forced to subsist almost wholly on cheatgrass which was very smutty. The grass crop seemed lighter in 1938 and Mormon crickets were quite abundant. The pasture was dusted with arsenic poison early in June, which destroyed many of the crickets, but enough remained through the season to eat a substantial portion of the succulent weed feed which otherwise would have been available for the horses. They developed no trouble from sore mouths from grazing over mature cheatgrass during either season.

During these two seasons, this 30.5-acre pasture supported 3 and 4 saddle horses in reasonably good condition at the average rate of slightly less than 1.6 acres per horse month. This compared favorably with the grazing capacity of well managed, good native range land and indicates a relatively high value of cheatgrass range for horses. It has often been stated that cheatgrass is practically worthless for pasturage after seed maturity, but this is not confirmed by this test. There were indications in 1938 that cheatgrass had reached or passed its maximum production and that perennial grasses and weeds were increasing at the expense of cheatgrass production so that there is no assurance that cheatgrass will continue with a grazing capacity of 1.6 acres per horse month over a period of years.

Samples from 96 plots, half of which were fenced and ungrazed, and half from grazed portion of this pasture, were used in 1937 for computing yield for cheatgrass and other species present, and as an indication of average daily consumption by the horses. Total yield of matured cheatgrass from ungrazed samples clipped in August was at the rate of 639 pounds per acre, while all other species yielded 76 pounds per acre. No fall growth is included in these yields. The difference in weight of grazed as compared to ungrazed samples indicates a daily consumption for all species combined up to mid-August of 33 pounds for each horse. Composition of the forage as previously mentioned indicates that 89 percent of this total or 29 to 30 pounds of this daily ration was cheatgrass. This amount corresponds fairly close with the requirement of timothy hay given by Henry and Morrison for maintaining an idle 1,000 pound horse.

It is not the intention to suggest from these data for two seasons that cheatgrass is equal to timothy for horse feed. This comparison and test does indicate, however, that cheatgrass range has a higher value for horses during midsummer and later than it has often been given credit for. Close observation during the past two winters on the results of wintering about 30 range cows on a ration of about 20 pounds of hay of which about one-third was cheatgrass, cut a little short of maturity, and the remainder alfalfa tends to confirm the experience of some stockmen that cheatgrass hay has considerable value for wintering cattle. Cases are, however, known where the sharp awns from overripe cheatgrass hay have caused sore mouths when fed in large quantities.

In the foregoing experiment, it was noted that certain plants were grazed in preference to cheatgrass. This suggests the warning that certain desirable plants in the mixture may be overgrazed by forcing animals to closely graze the cheatgrass. This is a questionable practice. It has been found that cheatgrass is largely a winter annual and production may be very low when moisture or other conditions during the previous fall are unfavorable for the seedlings to become established. When it is possible to so manage the range as to encourage other more reliable forage, that is ordinarily the safer procedure. Management to encourage cheatgrass is not advocated.

The belief is frequently advanced that cheatgrass is so aggressive that it will crowd out other more dependable native grasses but little evidence has been found on the ranges to support this view. Plowing, overgrazing, or other serious disturbance of native perennial grasses appears to be essential before cheatgrass can actually replace them. Dry cheatgrass provides a serious fire menace and has other objectionable features. In spite of its many shortcomings, cheatgrass has real value in protecting soil against erosion and because of its relatively good feeding value it may properly be considered as a valuable supplemental forage on many ranges rather than an unmitigated nuisance. Control by replacing it with more dependable species such as crested wheatgrass is a more logical and promising program in the cheatgrass problem than attempts to eradicate it. Further research is needed to determine more definitely the proper place of cheatgrass in range succession and in range management practices over a period of years.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 90 Missoula, Montana May 1939

DIRECT SEEDING IN THE WESTERN WHITE PINE TYPE

By

C. S. Schopmeyer

Current direct seeding studies on coniferous species in the western white pine type have produced some very encouraging results particularly in view of the fact that previous attempts at direct seeding have generally failed. The failures in the older trials probably were caused by lack of protection from the depredations of rodents, such as chipmunks and field mice, and to unfavorable site conditions. The success of the current studies is attributed to the use of adequate protection of seed spots against rodents and to the selection of more favorable sites.

Four latin square plots were sown in the fall of 1937 and four more in the spring of 1938. These plots are located in the Kalispell Creek drainage in the Kaniksu National Forest (Pend Oreille County, Washington) and in the drainage of the North Fork of the Coeur d'Alene River in the Coeur d'Alene National Forest (Kootenai County, Idaho). Both areas were clear cut and broadcast burned previous to the time of sowing. Comparisons of germination, survival, and degree of stocking were made between ponderosa pine, western white pine, and Engelmann spruce; between spring and fall sowing; and between spots protected from rodents with conical screens and unprotected spots. The type of screens used in these tests is shown in figure 1.

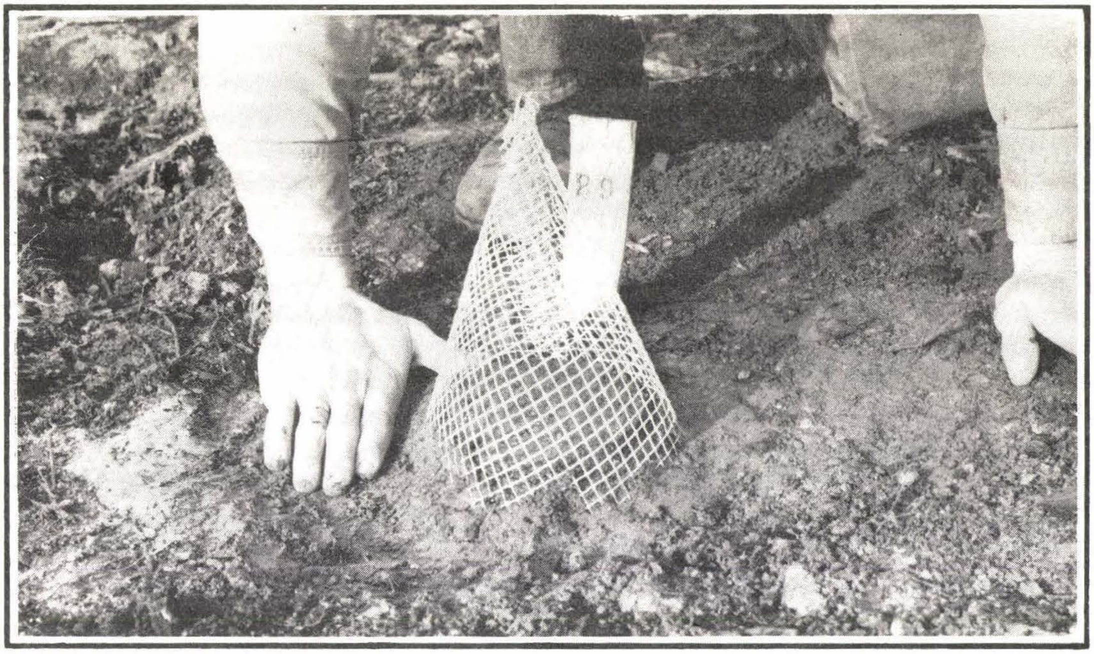

Figure 1.--Seed spot protected with conical screen.

Two fundamental requirements of a practical seeding operation are, first, that a sufficient number of seeds germinate to give rise to a fully stocked stand of timber and, second, that seedling mortality be sufficiently low to permit the development of a fully stocked stand. To show how closely the various treatments used in this study satisfy these requirements, data on germination, mortality, and degree of stocking are presented in table 1.

The season of sowing, the presence or absence of protection from rodents, and the size of seed each had a great influence on germination. Fall sowing of seed of all species resulted in an average germination of over 60 percent, as shown by the curves in figure 2, while germination of spring-sown seed was not more than 25 percent of the number of seeds sown for any of the three species. Low germination of spring-sown seed is attributed to unfavorable soil moisture conditions following spring sowing. The extremely low germination of less than 5 percent for spring-sown seed of western white pine was probably caused by the failure of the stratification treatment used on the seed of this species to complete the necessary after-ripening processes. These germination percentages, which were determined in field tests under screened enclosures outside of the plots, do not agree with the average numbers of seeds germinated per spot shown in table 1.

Table 1.--Germination, mortality, and degree of stocking in direct-seeding plots.[1]

Location of plots	Species	Germination				Mortality[2]		Stocked spots[3]			
		Screened spots		Unscreened spots		Screened spots		Screened spots		Unscreened spots	
		Fall sown	Spring sown	Fall sown	Spring sown	Fall sown	Spring sown	Fall sown	Spring sown	Fall sown	Spring sown
		Average number of seeds germinated per spot				Percent of germination		Percent of total spots			
Kaniksu National Forest	Ponderosa pine	24.4	5.6	0.5	0.2	5.4	19.0	100	65	25	10
	Western white pine	9.8	1.5	0.4	0.1	19.4	35.2	85	32	18	1
Coeur d'Alene National Forest	Western white pine	28.8	4.4	1.0	0.4	14.1	10.2	91	20	39	20
	Engelmann spruce	25.8	25.3	7.6	8.4	21.9	25.7	96	67	84	67
Average for all species		22.2	9.2	2.4	2.3	15.2	22.5	93	46	42	24

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[1] Each figure on fall-sown seed is based on 288 spots; each figure on spring-sown seed is based on 192 spots.

[2] Mortality for unscreened spots was omitted because of insufficient numbers of seedlings on which to base percentages.

[3] Number of spots having one or more seedlings at end of first growing season expressed as a percentage of the total number of spots sown.

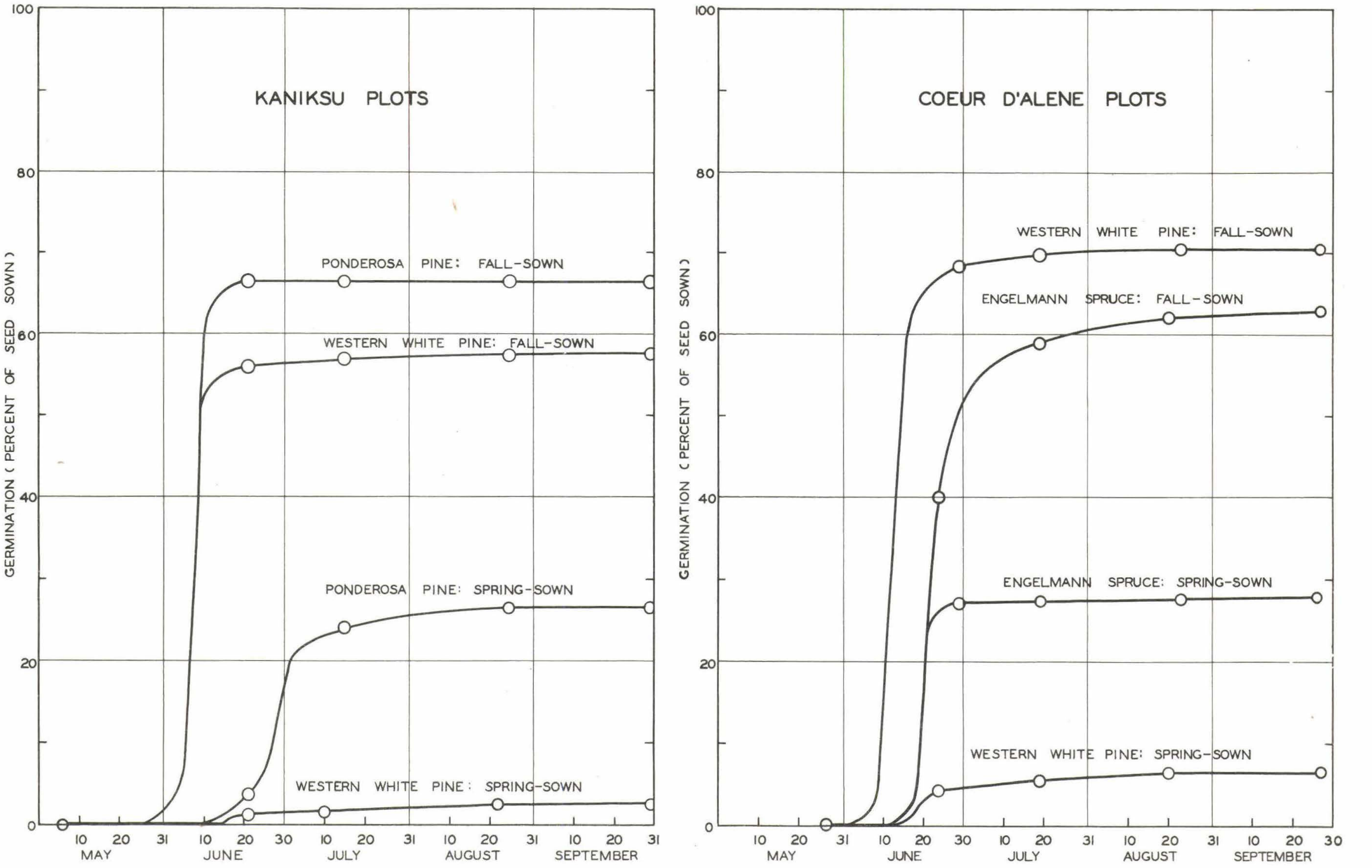


FIGURE 2. GERMINATION DURING THE 1938 GROWING SEASON IN DIRECT-SEEDING PLOTS ON THE KANIKSU AND COEUR D'ALENE NATIONAL FORESTS.

The inconsistency was probably caused by the fact that the number of seeds sown in each spot was not counted and hence was not the same in all spots, while in the germination test an accurate count was made of the number of seeds sown and the number germinated. Among the screened spots within the plots, fall sowing, which resulted in an average of 22 germinated seeds per spot, was much better than spring sowing which resulted in only 9.2 germinated seeds per spot. In the unscreened spots, rodent depredation was the limiting factor in germination; hence, the effect of season of sowing is not so apparent. Germinated seeds in unscreened spots sown with western white pine and ponderosa pine averaged less than one per spot in both the spring- and fall-sown plots. Destruction of seed by rodents undoubtedly caused this low germination because practically every unscreened spot showed evidence of rodent digging within 2 days after sowing. Unscreened spots sown with Engelmann spruce seed, however, had an average of 8 germinated seeds per spot in both the spring- and fall-sown plots. Apparently the small size of the seeds of this species made them less attractive to rodents.

First-year mortality, being only 19 percent of the number of seeds germinated in screened spots, was not a serious threat to the development of seedlings. No mortality percentages were calculated for seedlings in unscreened spots because of insufficient numbers of seedlings. Mortality in screened spots was less than half of that for either natural reproduction or planted trees. Average first-year mortality for natural reproduction on cutover areas over a period of 7 years (1927-34) was 43 percent for native species of the western white pine type. Average first-year mortality on all plantations in western Montana, northern Idaho, and northeastern Washington over a period of 26 years was 42 percent. Although a mortality percentage determined from the results of only one season cannot be used for predicting average expected mortality, the mortality observed in this study is indicative of what might be attained on selected seeding sites.

The number of seedlings killed by damping-off fungi, drought and insolation combined, and cutting by biotic agents was determined by inspection for four periods during the growing season. The percentages of seedlings killed by each of these three causes are shown in figure 3 for each of the four periods. Damping-off fungi were active on the Kaniksu plots only during May and June, while on the Coeur d'Alene plots activity continued during July. The early drying of the sandy surface soil on the flat sites on the Kaniksu plots may have inhibited the growth of the fungi sooner than on the Coeur d'Alene plots which were located on north-facing slopes. The cutting agents were active all through the growing season but were most active during

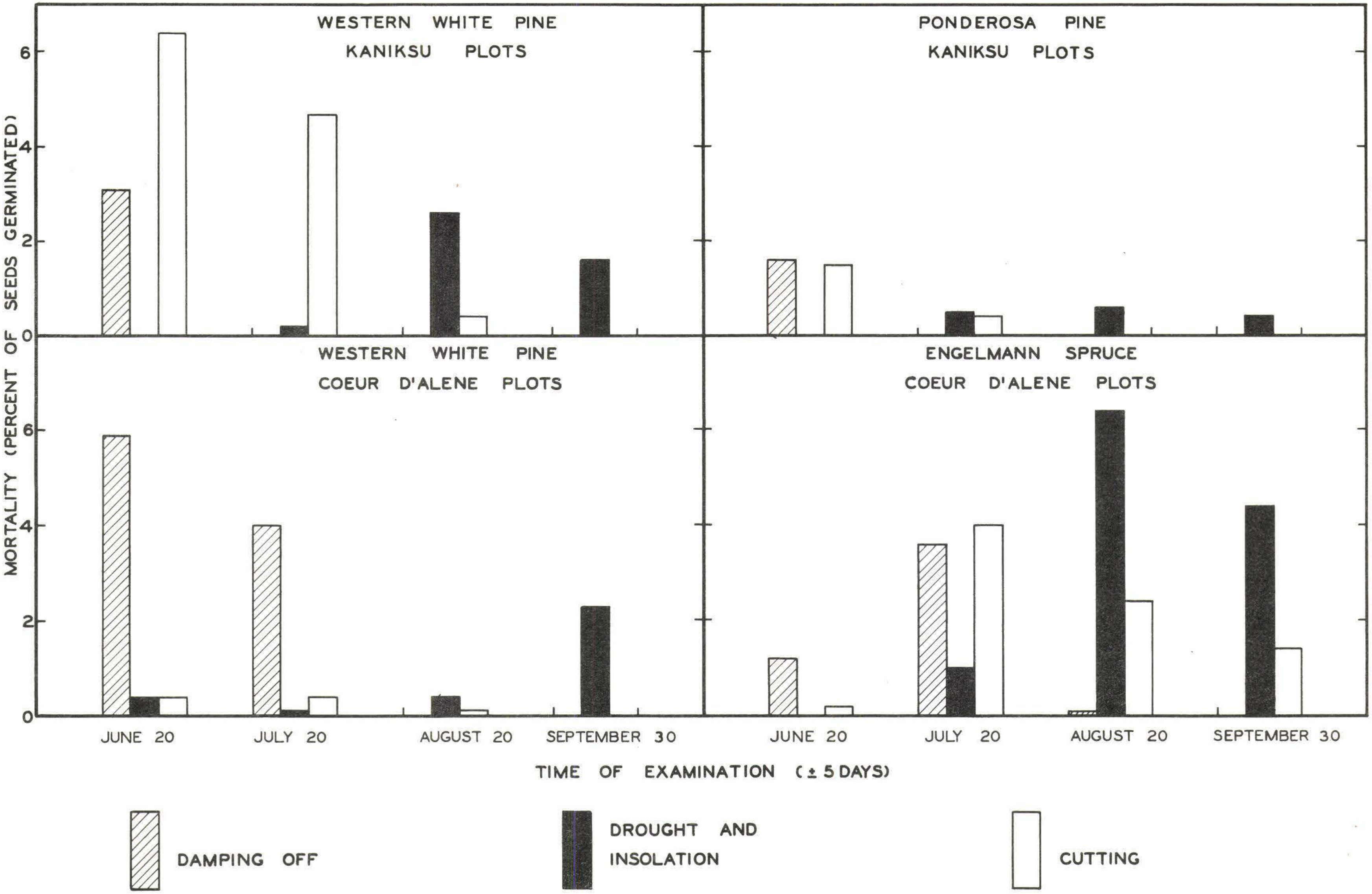


FIGURE 3. MORTALITY RESULTING FROM DAMPING-OFF, DROUGHT AND INSOLATION, AND CUTTING AT THE TIME OF EACH EXAMINATION DURING THE FIRST GROWING SEASON. PERCENTAGES ARE GIVEN ONLY FOR SCREENED SPOTS ON FALL-SOWN PLOTS

June and July. Losses from drought and insolation were first observed in July but did not become appreciable until August and September.

Analyses of the total mortality data summarized in table 1 show four interesting points.

1. The causes of mortality in the decreasing order of their destructiveness were cutting, drought and insolation combined, and damping-off.
2. Losses caused by damping-off were approximately the same for all three of the species studied.
3. Losses caused by drought and insolation combined were greatest in Engelmann spruce, intermediate in western white pine, and least in ponderosa pine.
4. Losses caused by cutting were greatest in Engelmann spruce, intermediate in western white pine, and least in ponderosa pine.

Cutting, the major cause of the losses observed in this study, was done in several different ways. Some seedlings were cut off at the ground line, others were cut off an inch or more above the ground line, and on a few the apical growth was cut off flush with the cotyledons leaving the latter intact. A number of different biotic agents seem to have participated in the cutting but none were identified. Since all forms of cutting were observed in screened spots as well as in unscreened spots, the damage apparently was not done by grazing animals.

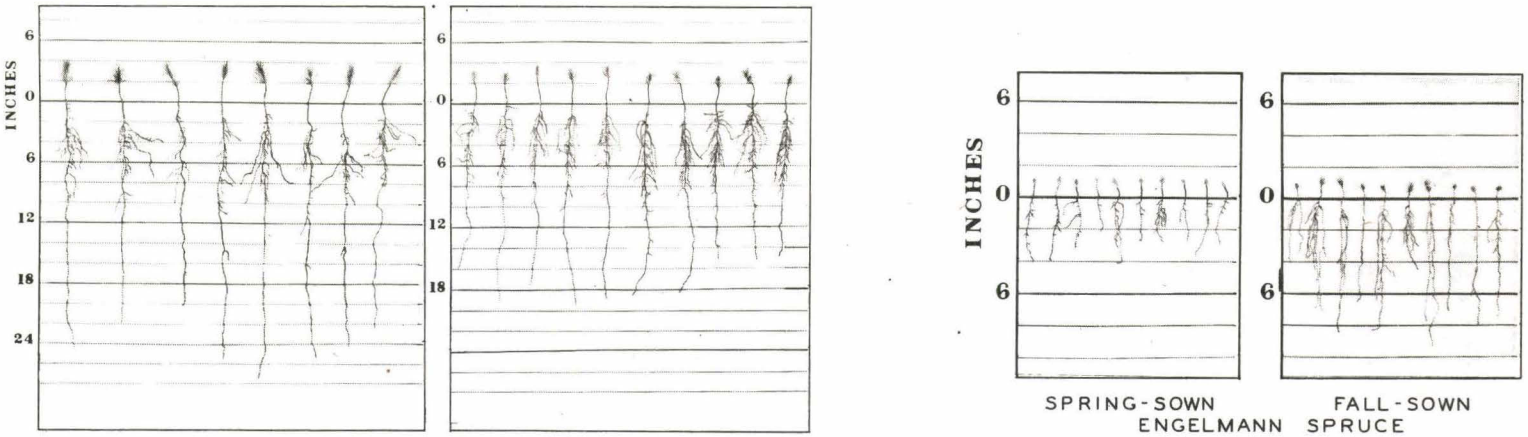
Drought and insolation losses seem to be correlated inversely with the relative depths of root penetration of the various species of seedlings. The total mortality percentages caused by drought after fall sowing in screened spots are 1.5 for ponderosa pine, 3.8 for western white pine, and 12.4 for Engelmann spruce while the average depths of root penetration for these species, as shown in table 2, are 15.5, 9.6, and 5.9 inches, respectively, for seedlings grown from fall-sown seed in screened spots. This inverse correlation can be explained readily on an ecological basis. As the summer drought progresses, the level of available water in the soil is gradually lowered. Hence, a seedling which can put down a long tap root may be able to absorb sufficient water to survive while the level of available water may go beyond the reach of a seedling with a shorter tap root.

Table 2.--Average lengths of roots and tops of all seedings excavated on direct-seeding plots at end of first growing season in field.

Species	Season of sowing or planting	Number measured	Length of roots	Length of tops
			Inches	Inches
Ponderosa pine	spring	33	18.0	2.9
	fall	60	15.5	3.6
Western white pine	spring	67	8.5	1.8
	fall	109	9.6	2.2
Western white pine 2-2-1 planted stock[1]	spring	5	14.3	8.5
Engelmann spruce	spring	58	4.2	1.1
	fall	55	5.9	1.2

[1] Two years in seed bed, two years in transplant bed, and one year in field.

The later start in germination and growth resulting from spring sowing as compared to fall sowing seems to affect the depth of root penetration. Table 2 shows that root penetration of seedlings of western white pine and Engelmann spruce was 1.1 and 1.7 inches greater when grown from fall-sown seed than when grown from spring-sown seed. Ponderosa pine, however, made 2.5 inches more root penetration when sown in the spring than when sown in the fall. Figure 4 shows these differences in root penetration and also differences in root habit far better than they could be described in words. Each group of seedlings in this figure were excavated from a single spot, with the exception of the white pine planting stock, and do not represent all of the individuals measured to get the averages shown in table 2. The western white pine nursery stock shown in figure 4 was planted on the site of one of the Coeur d'Alene seeding plots at the same time the spring sowing was done. The average net root penetration of this stock, which was root-pruned to 8 inches before planting, was only 6.3 inches while white pine seedlings grown from spring-sown seed made an initial root penetration of 8.5 inches during the first growing season. Seedlings of ponderosa pine, however, with a root penetration of 18 inches when grown from spring-sown seed and 15.5 inches when grown from fall-sown seed, appear to be much better adapted for survival on dry sites than either nursery stock or field-grown seedlings of western white pine. The relatively shallow root penetration of Engelmann spruce seedlings, only 5.9 inches,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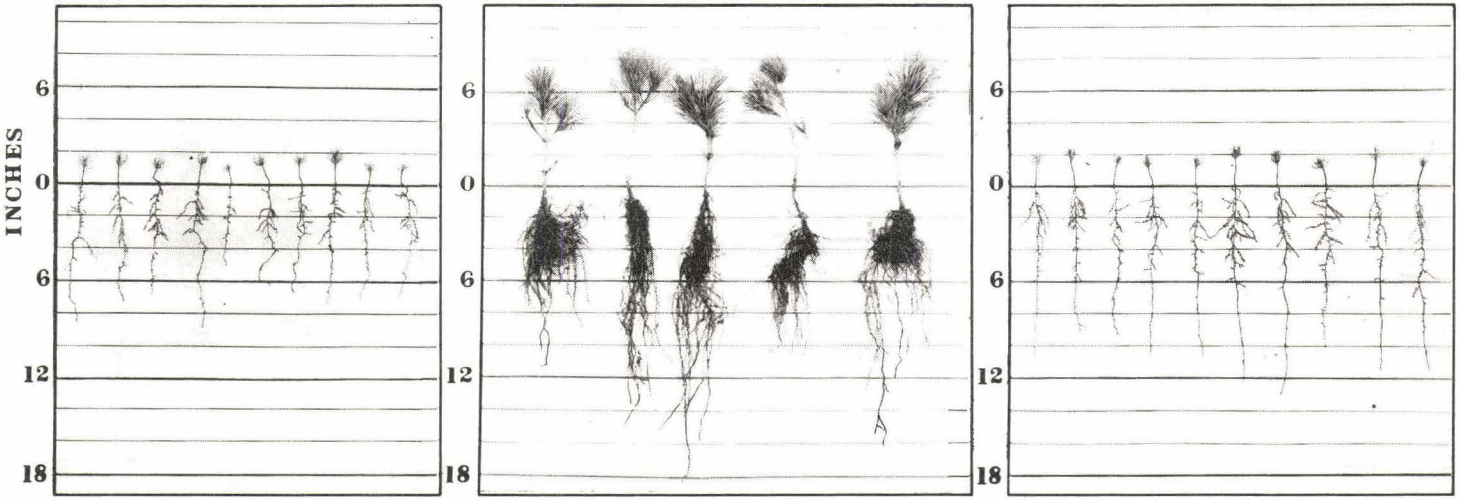
SPRING-SOWN FALL-SOWN
PONDEROSA PINE

SPRING-SOWN FALL-SOWN
ENGELMANN SPRUCE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SPRING-SOWN NURSERY STOCK: SPRING-PLANTED FALL-SOWN

WESTERN WHITE PINE

FIG. 4. SEEDLINGS GROWN FROM SPRING- AND FALL-SOWN SEED ON DIRECT SEEDING PLOTS AND 4-YEAR-OLD (2-2) WESTERN WHITE PINE NURSERY STOCK ROOT-PRUNED TO 8 INCHES BEFORE PLANTING. ALL PLANTS EXCAVATED AFTER FIRST GROWING SEASON IN FIELD.

shows that direct seeding of this species must be limited to the more moist sites where available soil moisture is maintained within reach of the short root systems.

The final criterion of the success to date of the seeding experiments is the percentage of spots with one or more live seedlings at the end of the first growing season. As shown in table 1 for all species, an average of 93 percent of the screened fall-sown spots had one or more live seedlings at the end of the first growing season. This percentage is very high compared to average stocking in plantations 1 year after planting. Stocking among the spring-sown screened spots, averaging only 46 percent, was much less satisfactory. The only species showing a reasonably satisfactory degree of stocking in unscreened spots was Engelmann spruce with one or more seedlings in 84 percent of the fall-sown spots and in 67 percent of the spring-sown spots. Screening apparently had no effect on the stocking among spring-sown spots, and among fall-sown spots stocking was only 12 percent greater in the screened spots. With the larger seeded species, western white pine and ponderosa pine, screening made a much larger difference in the stocking, being 3 to 5 times greater in the screened spots. The greater difference is probably caused by the greater attractiveness of the larger seeds to rodents.

The favorable results of these experiments cannot be attributed to favorable weather during the growing season. Weather Bureau reports show that the mean monthly temperature was higher than normal and precipitation less than normal for the 4-month period, June to September 1938, inclusive, in North Idaho. Hence, the summer drought was more severe than usual.

The results of these experiments show that direct seeding of large-seeded species such as western white pine and ponderosa pine can be done successfully if adequate protection from rodents is provided. On very favorable sites, small-seeded species such as Engelmann spruce can be seeded successfully without protection.

To make direct seeding economical, a cheaper means of protection than screening must be devised. Studies are now in progress at this station to develop economical methods for using poisons for rodent control on sites sown with large-seeded species. Further studies of the small-seeded species, Engelmann spruce and western red cedar, are also under way. If economical direct-seeding methods can be devised for use in this region, they will be a valuable supplement to planting.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 91 Missoula, Montana August 1939

PRODUCTION OF LUMBER, LATH, AND SHINGLES IN IDAHO AND MONTANA, 1938. [1]

The statistics presented in this preliminary summary of reports covering all lumber, lath, and shingle mills of record in Idaho and Montana are based on returns from the annual lumber census inquiry conducted by the Forest Service in cooperation with the Bureau of the Census. All 1938 figures shown in this statement [2] are preliminary and subject to possible corrections in the final report to be published by the Bureau of the Census.

In 1938, the large gains in volume of lumber production reported annually from 1933 to 1937 were largely offset by a decline which caused the combined lumber output of these two States to drop from 1,132,537 M feet for 1937 to 792,040 M feet for 1938. Total production of lath in the two States decreased 37 percent from 77,586 M pieces in 1937 to 48,752 M pieces in 1938.

In contrast with the decreased output of both lumber and lath during 1938, the upward trend in shingle production recorded for each year from 1933 to 1937 was not interrupted. On the contrary, the total quantity of shingles manufactured increased from 38,588 squares in 1937 to 40,086 squares in 1938.

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[1] By C. N. Whitney, special agent, Bureau of the Census, and associate forester, Northern Rocky Mountain Forest and Range Experiment Station.

[2] Released for publication.

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ROCKY MOUNTAIN STATION

As reported for each State separately, the Idaho shingle cut for 1938 amounted to 35,644 squares, a gain of 4.2 percent over 34,205 squares for the preceding year. Montana's shingle output in the year 1938 amounted to 4,442 squares, showing a gain of 1.3 percent over 4,383 squares reported in 1937.

Lumber production statistics for 1938 for each State by species are given in table 1.

Table 1.-Lumber cut by species, 1938, M feet B.M.
(Mills cutting 50 M or over)

Kind of wood	Idaho	Montana	Combined cut	
			Volume	Percent
Idaho white pine	286,754	21,139	307,893	38.9
Ponderosa pine	186,153	106,850	293,003	37.0
Douglas fir	48,963	39,930	88,893	11.2
Western larch	20,667	45,463	66,130	8.4
White fir	16,973	357	17,330	2.2
Spruce	3,431	6,373	9,804	1.2
Cedar	4,596	37	4,633	0.6
Lodgepole pine	1,820	1,350	3,170	0.4
All other	1,154	30	1,184[1]	0.1
Total	570,511	221,529	792,040	100.0
Lath, M pieces	36,907	11,845	48,752	
Shingles, squares	35,644	4,442	40,086	

[1] Includes 845 M hemlock and 339 M cottonwood.

The relative proportion of the total lumber cut produced by the larger mills of these two States was practically the same in 1938 as it was in both 1936 and 1937. In 1938, 85.6 percent of the aggregate cut of 792,040 M was manufactured by 29 mills each cutting 5,000 M feet or over, and 14.4 percent by 301 mills of smaller capacity cutting from 50 M to 5,000 M during the year.

In addition to the mills cutting 50 M feet and upward, 59 mills in Idaho and 86 in Montana reported production amounting to less than 50 M each in 1938. The aggregate additional production reported by these very small mills, not covered by cut figures included in table 1, amounted to 1,381 M for Idaho and 1,680 M for Montana.

The following tabulation compares annual lumber production records covering the 6-year period 1933 to 1938:

Table 2.-Reported total lumber cut, M feet B.M.
(Mills cutting less than 50 M excluded)

Year	Idaho	Montana	Aggregate cut	
			Volume	Percent of increase or decrease from preceding year
1933	316,471	125,126	441,597	+ 22.9
1934	457,089	171,841	628,930	+ 42.4
1935	609,212	233,633	842,845	+ 34.0
1936	723,804	295,233	1,019,037	+ 20.9
1937	797,492	335,045	1,132,537	+ 11.1
1938	570,511	221,529	792,040	- 30.1

For the past 6 years, from 75 to 78 percent of the aggregate lumber cut of Idaho and Montana has consisted of Idaho white pine and ponderosa pine. However, during that period the relative proportion contributed by white pine is shown to have steadily decreased from year to year while the proportion of ponderosa pine has increased in approximately the same ratio. In other words, a gradual decrease in the percentage of white pine has practically been counterbalanced each year by a corresponding increase in the percentage of ponderosa pine reported.

In 1933 the cut of white pine amounted to 50.8 percent and the cut of ponderosa pine amounted to 27.6 percent of the total volume of all species reported. In 1938 white pine contributed 38.9 percent and ponderosa pine 37 percent of the total output for the two States.

The proportional percentages of Douglas fir, western larch, white fir, spruce, cedar, hemlock, lodgepole pine, and cottonwood, which collectively have comprised from 22 to 25 percent of the total annual cut of Idaho and Montana since 1933, have fluctuated within only very narrow limits. From 1933 to 1938, 17 to 21 percent of the total cut has consisted of Douglas fir and larch. The combined cut of white fir, spruce, cedar, hemlock, lodgepole pine, and cottonwood has accounted for only 4 to 5 percent annually.

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APPLIED FORESTRY NOTES
NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 92 Missoula, Montana September 1939

OVERGRAZING INCREASES PRODUCTION COSTS BY REDUCING NUMBER AND WEIGHT OF RANGE CALVES

By
Leon C. Hurtt, Senior Range Examiner

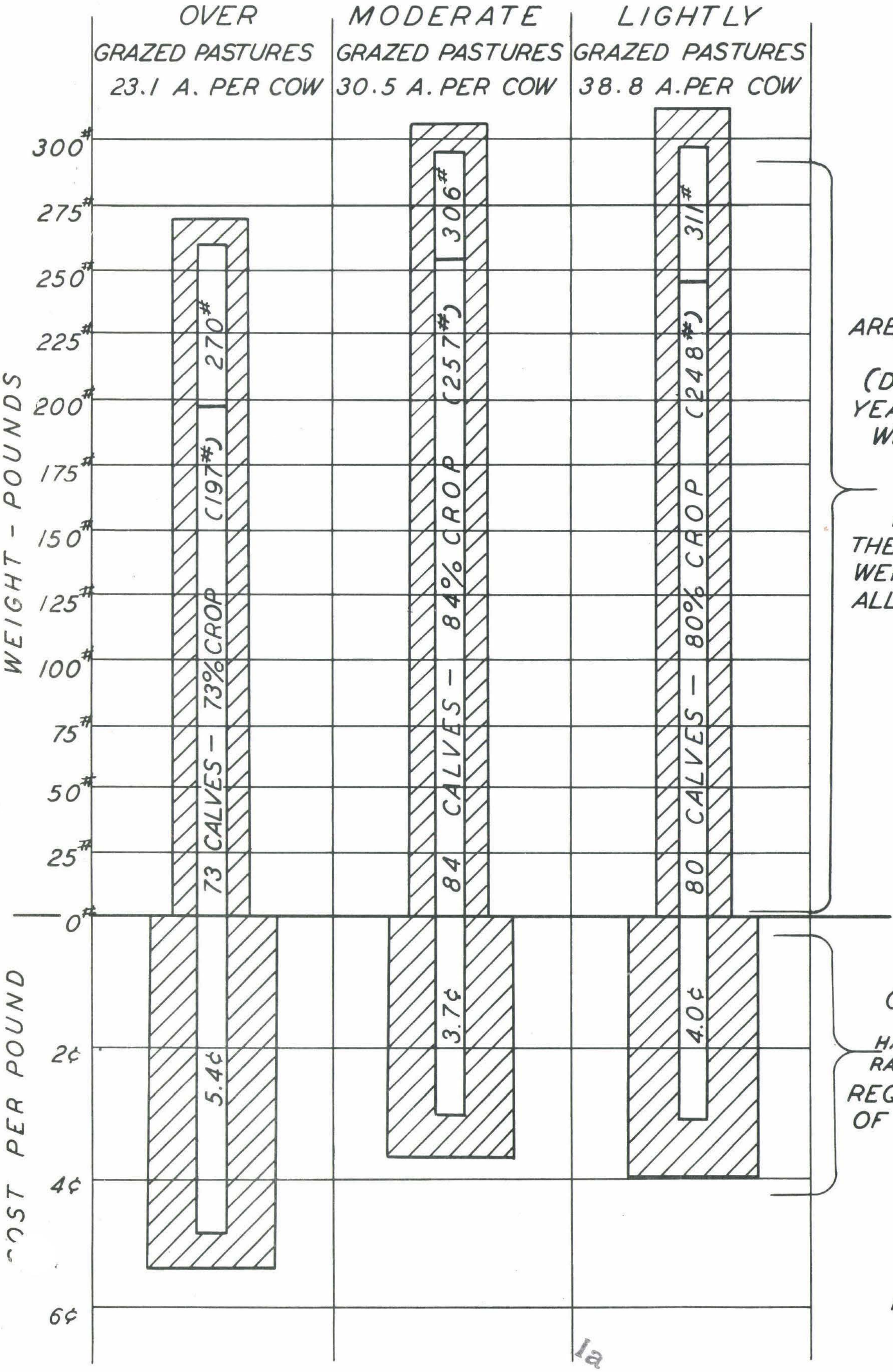
Overgrazing increases feed costs of producing range calves by more than one-third when compared to production costs on adjacent range grazed more conservatively. This is the result from a range experiment at Miles City, Montana, conducted over a 5-year period by this station in cooperation with the Montana Agricultural Experiment Station and the Bureau of Animal Industry. This experiment was started in 1933 on typical shortgrass range pastures on which blue grama, bluestem wheatgrass, niggerwool and buffalo grass predominated. The object was to find the best range utilization and management practices for such ranges. The experimental area was subdivided into three portions each grazed at a different degree or intensity of use - overgrazed 23.1, moderately grazed 30.5, and lightly grazed 38.8 acres per head, respectively, by three groups of 20 breeding cows and their calves. High grade Hereford cows of uniform age and breeding were selected for this test and grazed on the three adjacent sets of native range pastures. More supplemental feed in the form of hay was required for cows on the small pastures, otherwise the breeding, care, and other factors were the same for all lots.

Mainly as a result of the extreme drought during the 1934 and 1936 seasons, the density of vegetation on representative quadrats in all pastures had by early 1937 declined uniformly to approximately 10 percent of the 1933 density level. As a result of quite favorable weather during two successive growing seasons of 1938 and 1939, there has been a substantial increase from this low point, but the total density is still somewhat below the predrought level of 1933. Fortunately, there has been an unusual height growth of the drought-thinned grasses during the past two favorable seasons which has partially compensated in volume production for reduced density.

WEANING WEIGHTS & FEED COSTS

AVERAGE WT. CALVES – 5 YEARS

INTENSITY OF RANGE USE



ARERAGE WEANING WT.
AND CALF CROP.
(DURING 2 DROUGHT
YEARS CALVES WEANED
WHEN ABOUT FOUR
MONTHS OLD)

FIGURES IN PARENTHESIS SHOW WEANING WEIGHT PRORATED TO ALL COWS IN LOT

COST OF FEED
(RANGE PLUS HAY)
HAY @ $8.00 PER TON
RANGE @ 10¢ PER ACRE
REQUIRED PER POUND
OF WEANING CALF WT.

N.R.M. EXP. STA.
MISSOULA MONT.
SEPTEMBER 1939

The decline and subsequent increase in density of range forage was not, during the first five years, significantly different under the three intensities of grazing. This is readily explained by the fact that extreme drought in 1934 and 1936 completely overshadowed the effects of different degrees of use during the first stage of the experiment. The experiment will continue to follow trends of vegetation and response of cattle to intensity of grazing for several years.

Despite the uniform trends of forage density under these three intensities of grazing, the penalty exacted by overgrazing has been consistently evident from the beginning in the form of lower calf crops and lighter weaning calves on overgrazed as compared to more conservatively grazed ranges. During the 5-year period of this experiment, the 20 cows in each lot produced 73, 84, and 80 weaning calves that weighed 19,710; 25,704 and 24,880 pounds on overgrazed, moderately grazed, and lightly grazed range respectively. When prorated to all of the 20 cows of each lot, this amounts to more than 50 pounds of additional calf weight annually for each cow on the moderately and lightly grazed pastures over and above weights on the overgrazed pastures. The average calf crop, weaning weight, and the average production per cow (including dry cows), as well as the average feed cost per pound of weaning calf weight produced by each lot, are compared on the attached chart.

Attention is directed to the comparative feed costs shown by the bottom section of this chart. Because the cows on overgrazed ranges had to be fed greater amounts of hay, the cost of feed for each pound of weaning calf weight was increased to 5.4 cents per pound or more than one-third above that on either the moderately or lightly grazed lots. This is not all. The lighter calves from the overgrazed lot had a lower market value per pound. Furthermore, the cows of this lot were also thinner and sold for less when replacements were necessary. Thus the range operator who by heavy grazing reduces his calf production by 50 pounds or more per breeding cow, and at the same time is forced to feed more expensive hay to supplement cheap but inadequate range forage, places himself under nearly a hopeless handicap of increased feed cost and greater risks that tend to prevent profitable production.

Even though the density of vegetation on these ranges was reduced uniformly by the drought, the economic fallacy of overgrazing is clearly seen from the calf production data. It is anticipated that the penalty of overgrazing will be accentuated as the effects of overgrazing become significant, as is almost inevitable over a longer period of years. Such overuse usually results in accelerated run-off and erosion as well as cumulative range deterioration. Such a range practice thus leads into a vicious circle of higher costs and reduced returns.

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APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

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No. 93 Missoula, Montana November 1939

CHARACTER OF THE 1939 FIRE SEASON IN REGION ONE

By
H. T. Gisborne, Sr. Silviculturist

The 1939 fire season in the Northern Rocky Mountain region was the shortest that has been measured since the present rating system was commenced in 1934. The present season included only 61 days, July 12 to September 10, inclusive, from the beginning of sustained class 4 or higher danger to sustained class 3 or lower. The 1935 season included 100 such days.

The shortness of the 1939 season was offset, however, by the relatively high danger persisting without a material break from July 28 to August 25. September 8, 9, and 10 also were abnormally dangerous on most of the forests west of the Continental Divide. All forests except the Custer received good rains on September 11, 12, or 13 which ended the fire season.

As shown by the following tabulation of percentage of worst probable danger for the western forests, the 1939 season rates as average in fire danger, not a single forest rating critical (66 percent or more) and none rating easy (33 percent or less). It is noteworthy that this is the third consecutive year with no forests rating as critical. These ratings are in all cases for the period July 1 to August 31, inclusive, and are based upon a July-August average of class 5.5 equaling the worst probable or 100 percent, with an average of class 2.8 equaling the least probable or 0 percent.

Forest	1934	1935	1936	1937	1938	1939
	Percent of worst probable					
Bitterroot	59	59	44	61	39	52
Cabinet	74*	48	70*	50	54	60
Clearwater	78*	52	51	50	37	45
Coeur d'Alene	63	48	52	36	48	60
Flathead	85*	52	69*	58	48	56
Kaniksu	59	30	56	39	50	62
Kootenai	67*	44	77*	47	52	58
Lolo	78*	59	77*	58	44	60
Nezperce	81*	70*	56	54	37	59
St. Joe	63	59	49	43	41	56

* Identifies ratings of "critical."

The past season, like that of 1938, brought the highest danger, from 60 to 62 percent, on the contiguous Lolo, Cabinet, Coeur d'Alene, and Kaniksu Forests. While much of this rating was definitely due to extremely dry fuels and consequently rapid rate of spread of fire, a material factor was reduced visibility caused by the long drawn out Mica Peak and Spirit Lake fires to the west of these forests. Likewise the smoke from the shorter duration Gleason Mountain fire on the Kaniksu affected most of that forest and parts of the Kootenai, while the Kelley Creek fire on the Nezperce reduced visibility over most of its area and on parts of the Lolo. In all cases, danger was definitely higher due to this condition and more lookouts had to be used while these smokes prevented the ordinary detection system from insuring quick discovery at small size.

The outstandingly low rating for the Clearwater Forest is believed to be due partly to exceptionally beneficial June and early July rains, and partly to the fact that visibility in that area was not materially reduced by large fires to windward. Furthermore, the Clearwater reported lightning storms on only 14 of the 83 days between June 20 and September 11.

Lightning, which was an almost continuous threat in 1938, was a concentrated menace in 1939. Against a 15-year normal of 58 lightning storm days in the 83 days between June 20 and September 11, the 10 western forests this year reported storms on only 40 days. The customary epidemic of storms on July 10 to 15 occurred again this year on every one of the 17 forests in this region. These storms brought generally good rainfall, however, and fuel moistures were sufficiently high to favor easy control of the few fires that resulted.

The widespread storms of August 25 to 28 were of a different type and came following a period of extremely low fuel moistures. As a result the Forest Service had to meet the organization-taxing load of 716 fires in the last six days of that month. The Gleason Mountain fire on the Kaniksu was the only one of these that reached really large size. State and private timber protective organizations were subjected to a similar overload of fires.

Weather Bureau reports for the past season show that most of the region west of the Continental Divide experienced an April 1 to August 31 deficiency in rainfall of from 20 percent to 60 percent. The Bureau records also show high winds of 20 m.p.h. or more average for 24 hours at one or more places on July 16, 17, August 6, 12, 28, and September 5. Such windy days are the very ones that so often sweep a fire out of the small and easy size and put it into the size that actually makes weather of its own. These highly dangerous days cannot be met successfully except with an organization larger than needed during ordinary weather, yet it is always very difficult and often impossible to expand the organization quickly enough to be ready when the high winds arrive. The accident or chance of fires starting or not starting on these bad days is one of the factors that often make the difference between a bad and a good fire season from the standpoint of the protective organization records. This year the Gods, and the incendiarists, were reasonably kind.